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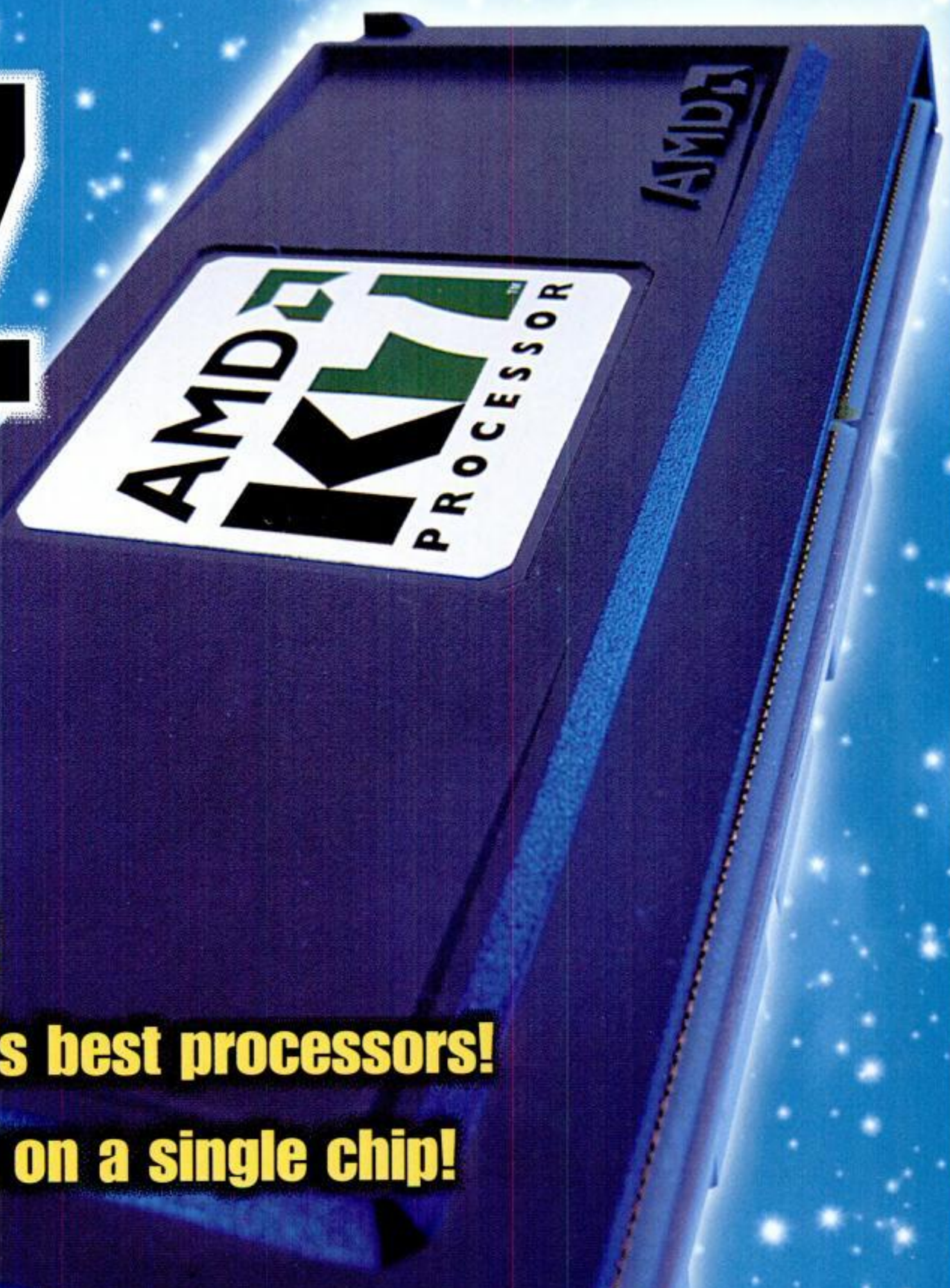

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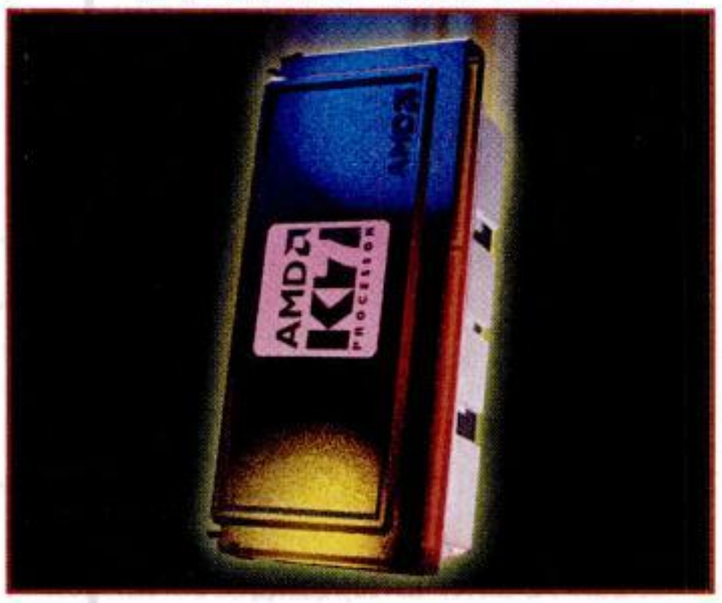

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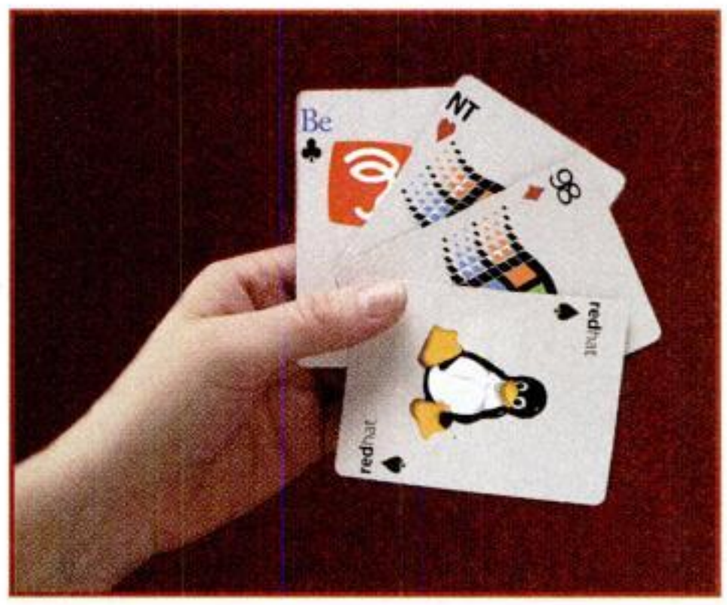

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EDWORD

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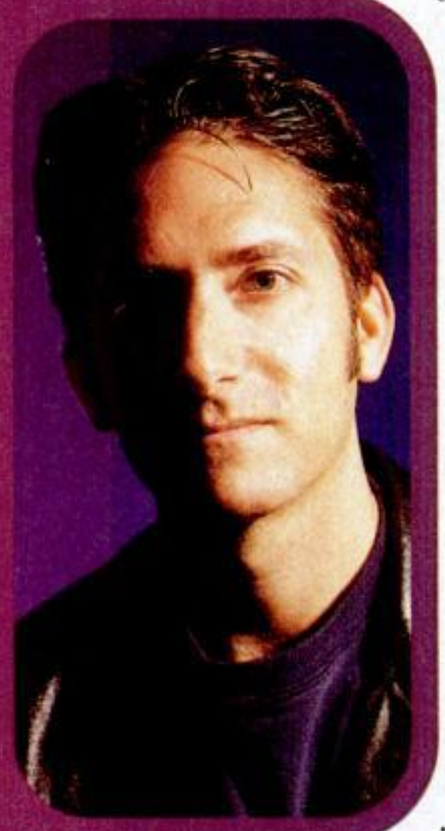

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Do you want to trade? After all, if you pick the *right* core architecture—the grand prize—you could possibly enjoy greater performance dividends than anything you might gain from an extra 150MHz. So will you trade? No? Last chance. No? Very well, then.

You made the right choice!

The beauty of sheer clock speed is that it is doesn't discriminate against poorly written software code.

The beauty of sheer clock speed is that it is doesn't discriminate against poorly written software code—it speeds up all apps, across-the-board. And while it's true that some tasks run faster on Pentium IIIs and others run faster on Athlons because of idiosyncrasies in their architectures, a 1GHz CPU from either family should smoke an 850MHz CPU from either family in any given app. When it gets to the point of a 150MHz trade-off, the two CPU cores suddenly start looking much more similar than dissimilar, and clock speed will almost always make up the difference.

This month we celebrate the Athlon's climb to 1GHz. How did AMD reach the summit? Certainly, the Athlon's super-pipelining strategies (see the sidebar on page 41) allow it to reach fast clock speeds with nice headroom. But AMD also boast a kick-ass process technology and fabrication facility. Manufactured at a 0.18-micron process with aluminum interconnects, the Athlon can run very fast without emitting a prohibitive amount of heat. Dot-one-eight aluminum won't scale forever, however, and before AMD hits a ceiling, it will segue to copper interconnects in order to reach even faster speeds. The upshot: AMD has more than enough process technology to get through the proverbial winter.

This leads us to fabrication, which is where AMD really deserves kudos (at least for the sake of this necessarily simplistic breakdown; architecture, process technology, and fabrication success are all inextricably linked). Three years ago, AMD was the poster child for low yields—it couldn't produce enough fast-running chips for OEMs to fill orders for the high-ends of their product lines. But now, AMD seems to have its yield issues well under control, and the mass release of 1GHz CPUs at least a month ahead of schedule is AMD's real success story. After all, any company can make at least a small batch of air-cooled 1GHz CPUs; the key to winning the overall race is fabbing 1GHz CPUs en masse, and relegating only a relatively small number to the 950MHz, 900MHz, and 850MHz bins.

Critics can knock the importance of clock speed with some validity, because architectural peculiarities can indeed have a noticeable effect on performance. Tom Halfhill, our Fast Forward columnist, says, "Clock speed is analogous to engine RPM. It says how fast a chip is running, but it says nothing about the amount of work accomplished during each cycle." Of course, Tom is right, but until Intel and AMD begin the process of mothballing P6 and K7, and releasing their new cores, we'll take sheer clock speed over anything hiding behind one of the mystery doors.

—Jon Phillips, editor-in-chief

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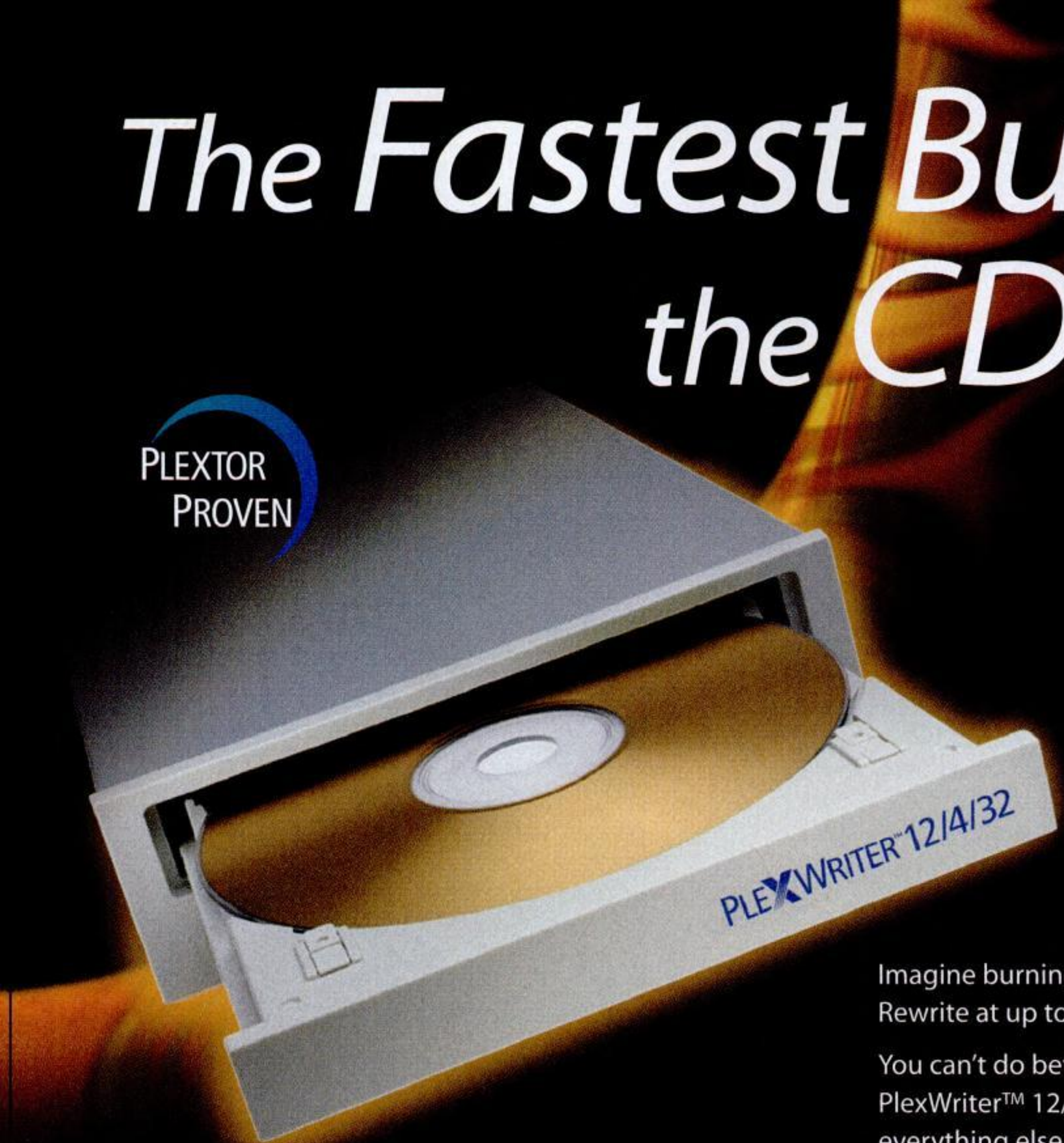

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Anders Incites a Reader Riot

The March how-to article on building a mobile MP3 player generated unprecedented droves of reader e-mail. Strike that—the word "unprecedented" doesn't do the deluge justice. For every piece of e-mail concerning other parts of the magazine, we received 20 e-mails concerning the "Brownworth Box." No lie. Some readers wanted to know more about the construction process, while others wanted to suggest alternative parts. Some wanted to congratulate Anders for his ingenuity, while others wanted to complain about the box's price and limited utility.

No matter how you slice it, it seems that the how-to cut to the core of our readers' fanatic sensibilities. If you have an equally dynamic homemade PC project that you'd like to share, e-mail **editor@maximumpc.com** and make your pitch. And, by the way, if you're wondering what Anders looks like, check out page 57 of our April issue—he's the explorer in search of the perfect case.

Mobile MP3 Malarkey

I was surprised and intrigued by the March issue "MP3 Street Illegal" story on how to build a mobile MP3 player. I was hoping for something inexpensive and simple; something that PC enthusiasts could assemble from spare parts we have lying around. Instead, I found something that's neither a PC nor a laptop, but a lot of both, and laughably expensive. This is a joke, right? I should pay $1,300 for a machine that serves no other function than to play MP3s? You're pulling my leg, aren't you? And how many people need 20GB to store MP3s?

—Dran

Editor-in-chief Jon Phillips replies:

The "MP3 Street Illegal" article detailed the parts that Anders Brownworth used when he created his baby from scratch. But as we stated in the introduction of the article, readers are encouraged to improve upon his design, and implicit in this suggestion is the idea that anyone can use cheaper parts.

The Brownworth Box can be an expensive proposition even if you cut corners on a few components. But that's the rub with a computer you build from scratch. If you buy your parts at retail prices, the overall cost of your PC can be higher than an OEM model. But what you gain in return is a box built to your exact personal specifications, and an invaluable amount of PC insight. The best way to learn how to fix computers is to build one yourself.

We published the article for a number of reasons: to celebrate the creativity of a die-hard PC hobbyist; to teach our readers about the special considerations that go into mobile, pizza-box configs; and, of course, to help people build a mobile MP3 player of their own. We like to think that even if you have no intention of building the Brownworth Box, you'll still enjoy the article as a good read.

Dran was one of many readers who thought the Brownworth Box was overkill. Some people wrote that similar dedicated mobile MP3 players are available on the retail market for half the price. True enough, but the beauty of the Brownworth Box is that it is a fully functioning PC capable of running Linux, which is necessary to run Anders' *Route 66* software. No retail MP3 player runs *Route 66*, which features unique playlist controls that give you a fully customized audio experience as you drive.

As for the necessity of a 20GB hard drive: You'd be surprised by how quickly a true MP3 fanatic can burn disc space.

I should pay $1,300 for a machine that serves no other function than to play MP3s? You're pulling my leg, aren't you?

He'll Beat Any Price!

While the March article "Cheap Thrills" was interesting, I would like to point something out. The article was about "the best" PCs for under $1,500. I'm just an average tech person, but I could put together a $1,500 system that would run rings around any of the machines in your article. I haven't done much comparison shopping, but check out these prices, most of which were pulled from ads in the March *Maximum PC*.

- case: Enlight Mid-Tower ATX; $79, page 95
- motherboard and processor: ASUS K7-M with Athlon 550; $419, page 92
- Athlon fan/heatsink: $20, page 95
- memory: 128MB of PC133; $177, page 95
- videocard: Viper II Savage 2000; $184, page 93
- soundcard: Sound Blaster Live! Value; $59, page 95
- hard drive: 13.6GB Western Digital UDMA/66; $133, page 93
- CD-ROM drive: Creative Labs 52x; $57, page 95
- floppy drive: generic; $10 from any local computer shop
- modem: 3Com 56K Winmodem; $43, page 93
- speakers: Eastern/Boca 360W speakers; $42, page 95
- keyboard: Microsoft Internet Keyboard; $30, page 79
- mouse: Microsoft IntelliMouse PS-2; $25, page 95
- 17-inch monitor: $175 as priced by *Maximum PC*, page 40
- OS: Win98 2nd Edition: $105, page 95

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My total is $1,558. OK, so I came in $60 over budget. But you get the point. Your "average" *Maximum PC* reader is not going to go out and buy a $1,500 prepackaged box. Most likely, he or she will make a machine similar to the one I proposed above. I would suggest that you keep your "average" *Maximum PC* reader in mind when writing articles.

—Justin Key

Editor-in-chief Jon Phillips replies: I have no idea how Justin knows so much about our "average" reader because I myself am still trying to draw a bead on this elusive individual. But I do know that *Maximum PC* readers actually have very diverse buying habits and, for what it's worth, survey data tells us that a majority of our readers buy pre-fab systems. Of course, of all PC magazines, *Maximum PC* probably also boasts the highest percentage of readers who build PCs from scratch.

Some of our readers want the convenience of buying a pre-fab system, and its accompanying warranty and tech support. Others want to explore the joy of building a system with their own two hands. We support both groups. We also believe the two things that all *Maximum PC* readers have in common are a deep-seated passion for PC hardware, and a desire to learn more about how it all works.

Justin did an excellent job of researching prices and beating the OEMs at their own game. We typically find that OEMs will always win the battle of balancing price and power, but Justin's config looks like a winner. The only question mark is whether his mobo/CPU combo was selling at such a low price when the "Cheap Thrills" OEMs were configuring their systems.

What About Athlon?

In your story about cheap PCs, you picked some real dogs. Yes, these systems are affordable, but others out there have better performance for about the same cash. For one, I can't believe there were no Athlon-based systems mentioned. You can't tell me the Athlon wouldn't have performed better than the P-III. In fact, I have a low cost Athlon system that beats all those in the article. I think you could have gathered a better crop of systems to represent the sub-$1,500 market.

—Jack Beggs

Reviews editor Josh Norem replies: To be honest, we thought we would see some Celeron-based PCs in the roundup, but not Athlons. The first reason is cost. We put in requests for systems in December 1999, when the Athlons were priced much higher than their Pentium III counterparts. Vendors were allowed to charge only $1,500 on the machines they submitted, so devoting a third of that sum to the processor wouldn't allow for much else.

Interestingly, one vendor did agree to ship us an Athlon 700 with 128MB of RAM, a TNT2 card, an ATA/66 hard drive, and a 17-inch monitor, but unfortunately that PC never arrived.

As far as our mix of systems, we didn't want to have a hand in determining which machines fare well or poorly, and asking one vendor to send a P-III and another to send a Cellie would surely sway the results of the roundup. Therefore, we set the price at $1,500, and let the vendors decide how to configure their systems under this single parameter.

Kibbles and Bytes

My dog, Beau, thoroughly enjoys your magazine. Thank you for bringing happiness to the family.

—Crittle Steele

The Maximum PC Watchdog replies: Woof. Woof-woof-woof. Woof? Rau-oof!

Smut Be Gone!

On the last page of the March issue, you guys ran an article about *Eyeguard*. Is this a hoax? Software that spots "fleshtones"? Does is work with black skin? There was no link to *Eyeguard*, so I figured it was a hoax. If not, next time please add links the software that you review.

—Tim Hoskins

Editor-in-chief Jon Phillips replies: The URL omission was an oversight—*Eyeguard* is very real, and you can learn more about it at **www.eye-t.com**. Intended to stymie viewing of online pornography, the software can discern a wide range of multicultural fleshtones according to a sliding sensitivity threshold. When too much skin appears onscreen, the software can either block the screen entirely, or record the event in a log for later perusal. The first option is intended to keep smut away from kiddies. The second option is intended to monitor employee porn habits. We found that *Eyeguard* does indeed work, but it can't discern the difference between photos of gold-medal swimmers in Speedos (which *should* be blocked) and the lovely lasses of *Tampa Bay Tushy Fest* (which *shouldn't* be blocked).

Audio/Modem Who?

I've been trying to find out about the Audio Modem Riser (AMR) connector featured on some of the newer mobos, including the Intel CC820 and VC820. Your Terminator doesn't include a definition for this yet. Can you tell me:

- What is the AMR spec?
- Why was it developed?
- What are the benefits and pitfalls of using it?
- Who is developing products for it?
- What can an system builder do with it?

—Chas Hall

News editor Gordon Mah Ung replies: The Audio Modem Riser was designed by Intel to help system OEMs cut costs. A small daughtercard featuring basic audio and phone ports fits into the AMR connector; actual audio and modem processing is handled in software, and processed by the CPU rather than by dedicated audio and modem DSPs. Although the spec allows PC makers to use dedicated DSPs, most users will likely opt for soft versions to save cost.

The problem with host-based audio and modems is that they consume CPU cycles. But do you need all of your CPU cycles? Some OEMs claim that you don't in this age of speedy processors, and that's why softDVD solutions have been deployed since the advent of the 450MHz P-II.

You see where this is leading. Intel and AMD would love for you to increasingly rely on the CPU to do most of the PC's work. The danger is that when you play a 3D game online and it sucks up almost all of your CPU cycles, your modem connection and sound start to slip. When you're watching a DVD movie, chances are slim that you also surf the Web and listen to multiple audio streams.

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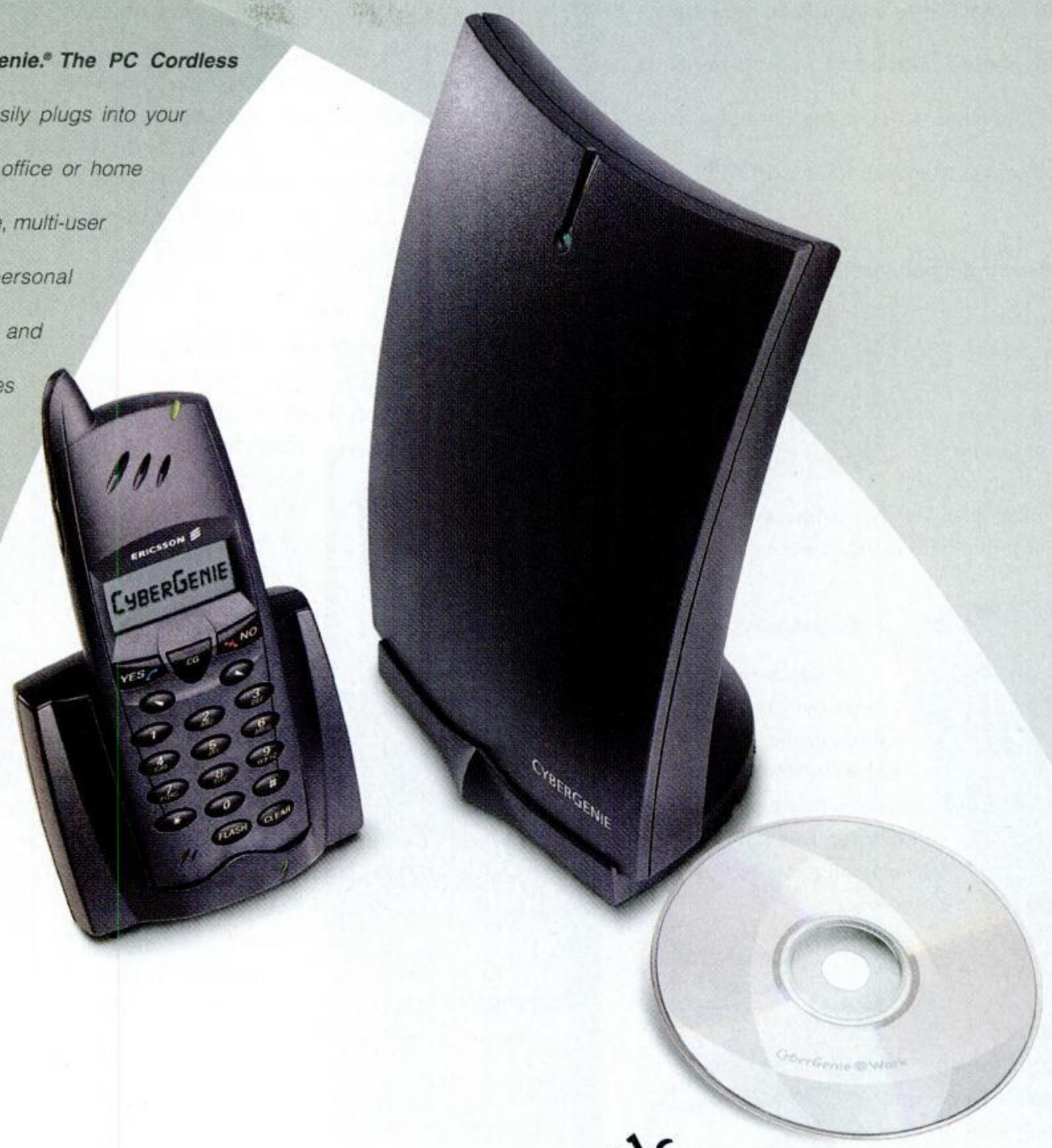

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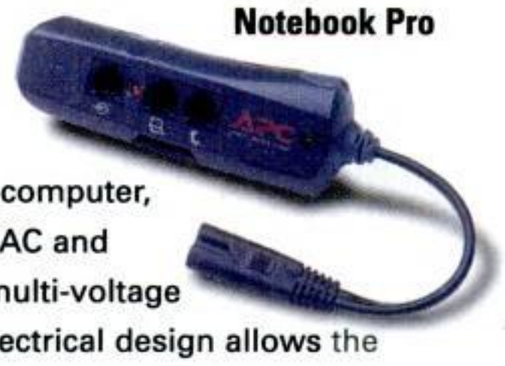

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And the K6-III?

Having purchased an AMD K6-III 400MHz from an online retailer, I'm wondering why it's difficult to find a K6-III now. I've also noticed that many OEMs have dropped K6-III 400s and 450s for higher-speed K6-IIs. Does the higher speed offer a counterbalance to the on-die cache of the K6-III?

—Nathan Borg

Editor-in-chief Jon Phillips replies: The K6-III is dead—at least on the desktop. AMD plans to relegate the K6-III to notebooks from here on. The idea is to stuff "value" PCs with K6-IIs that boast speeds as high as 533MHz, while midrange systems will jump straight into Athlon territory, with speeds starting at 550MHz.

The K6-III is dead—at least on the desktop. AMD plans to relegate the K6-III to notebooks from here on.

As many readers know, the K6-III is simply the K6-II with 256K of full-speed, on-die L2 cache. We haven't done any K6-III vs. K6-2 testing, but we trust that higher clock speeds will surely compensate for the lack of on-die L2. Just make sure your K6-II mobo has discrete L2 cache onboard, because you'll need some L2 cache, even if it runs at the speed of your system bus.

Desktop Amadeus

I've heard that a PC can produce music from sheet music passing through a scanner. Is this really possible? Is there a program that permits this?

—Guyn27

Contributing editor David Battino replies: To convert sheet music to audio, use Musitek's $400 *SmartScore* (**www.musitek.com**), a program that combines optical character recognition (OCR) with music notation editing and MIDI playback. In conjunction with a TWAIN-compliant scanner, *SmartScore* reads sheet music containing up to 32 staves, and converts it to a MIDI file that you can play back on your soundcard. Musitek also sells a $149 version called *SmartScore Piano Edition* that's limited to reading two-line staves.

Like all OCR programs, *SmartScore* invariably makes incorrect guesses as it reads, so you'll need to spend some time cleaning up the scanned data before converting your masterpiece to MIDI. You'll also need to insert tempo and dynamic markings—which *SmartScore* ignores—and assign each line to an appropriate MIDI sound.

At this point, you'll still have a robotic-sounding performance, but this is a shortcoming of standard music notation, not *SmartScore*. Notation only displays the basic parameters of a composition; the musician must use his or her talent to shape the performance. The best use of this technology is to quickly audition a piece of sheet music or import it into a high-end notation program such as Coda's *Finale*.

Static About Static

In February's issue, under the article "Why 2D Matters," there is a photo of editor Sean Downey doing some testing with your standard test bed. Why isn't he wearing a wrist strap while he handles static-sensitive boards? I am a field service tech in Silicon Valley, and work at some of the biggest companies, and what they all have in common is they are deadly serious about electrostatic discharge (ESD) precautions. Some companies use special ESD flooring (expensive!) and all workers wear at least one foot-strap at all times. You should at least use a wrist strap in the photo to set an example for your readers.

—Robert Matthews

Features editor Sean Downey replies: I could say that you didn't see the anti-static mat I was standing on, or the grounding mesh pants, ankle straps, and big-ass rubber boots that I wear when I install a new videocard. But the fact is that I don't regularly use a grounding device when handling hardware in The Lab. Although we take ESD precautions in The Lab, we also try to avoid creating a "white lab coat" environment that doesn't represent real-world experience. When working on PCs, we always ground ourselves first by touching the power supply.

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Intel Beats AMD To X-Box

Microsoft Introduces PlayStation 2 Killer That May Threaten PC

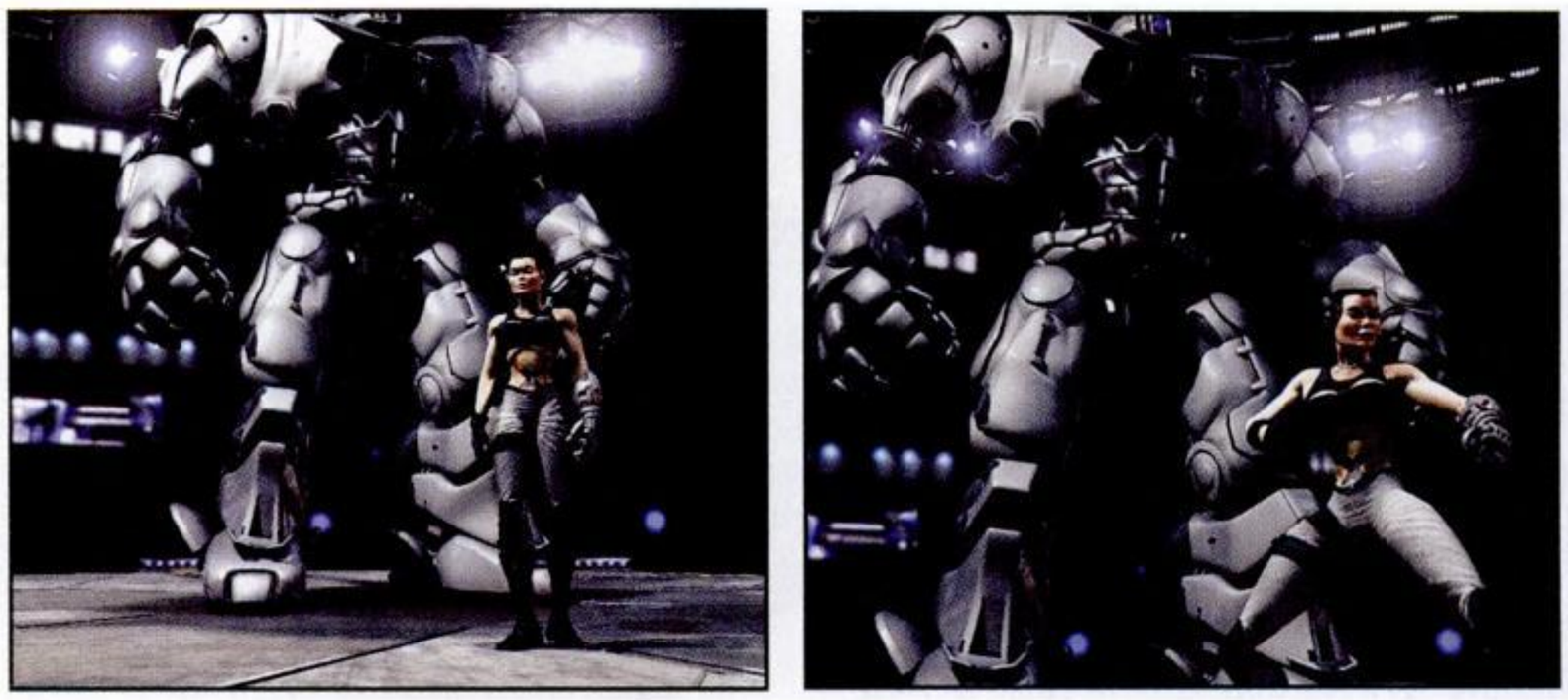
It should have been the crowning achievement for AMD. At the annual Game Developers Conference (GDC), Bill Gates was to have named the Athlon CPU of choice for its secret gaming console, the X-Box.

Instead, Gates dropped a bombshell that not even the AMD employees in the audience expected: The X-Box console will ship with an Intel Pentium III.

Microsoft's decision to switch chip suppliers was later than an eleventh-hour call—it was more like 11:59. In fact, some observers still insist the demonstrations and prototypes Microsoft showed at GDC were running on Athlon power. AMD had reportedly started production on some X-Box components. And some Microsoft officials didn't know of the switch until that day.

What went wrong? AMD is spinning the blow-off as a minor deal. "It's outside of our primary market," says AMD spokesman Drew Prairie. "We're focused on high-performance PCs."

Prairie says Microsoft made a basic business decision and is still a valued AMD partner. "We simply weren't prepared to give the processors away or turn it into a scorched-earth price-war with Intel."



Microsoft says this demo exploits just a small percentage of the X-Box's full graphics capabilities.

Others were not so kind. "At the last minute, Microsoft f-cked us," one angry AMD employee told *Maximum PC*. "We worked with them for months and the result is, they screwed us."

"Intel bought the business, that's really clear," says Rob Enderle, an analyst at Giga Information Group. Enderle says that if the larger supplier can match the smaller supplier's price, it makes perfect sense to go with the larger—and presumably more stable—supplier.

Microsoft officials toed the company line when asked about the swap, saying Intel's resources and experience can bring X-Box to fruition faster and with fewer problems. Intel officials would not disclose the price or details of the deal, but did say that people are fooling themselves if they believe Intel will give the P-IIIs away or lose money on them.

It appears AMD won't spend much time licking its wounds. There's buzz that the company has approached Mattel, of Intellivision fame, about making a new console. AMD wasn't the only loser in the X-Box game. Right up until launch time, strong speculation suggested that X-Box's graphics would be handled by Gigapixel. But Gates announced that Microsoft will equip X-Box with a custom chip from nVidia. There's no codename for the chip, but it's been internally referred to as XGPU or X-Chip. Gigapixel was left out of the deal, an official with Gigapixel says, because Microsoft needed to nail down a hardware platform so developers could begin working almost immediately. "Life goes on," the Gigapixel manager said.

Yesterday's hardware

The X-Box's processor will hardly be state-of-the-art—

SPIN CYCLE

This month's top stories broken down ▶

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
Spam Law in Question	A Washington state superior court judge has struck a blow against the nation's most aggressive spam law.	An Oregon man was charged with violating Washington's law against sending unsolicited mail with a forged header and false subject line.	Judge Palmer Robinson says the state law violates the Constitution's clause regarding interstate commerce.	Feh. We recommend spammers be punished with stockade-like humiliation, where people can fling regurgitated Spam at them.
Group wants Gov't out of Cable	A new group calling itself Net Compete Now wants the federal government to stay out of broadband cable regulation.	Net Compete Now says innovation will be hurt if the government forces cable providers to open their systems.	Consumers will benefit if cable companies are left to work at their own pace.	Smells like a payoff. If phone lines are shared, why can't cable be?

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Microsoft plans to use a Pentium III at 600MHz or higher. The speed could creep up, but if it does, prices will creep up as well. Enderle wonders whether people will even want a 600MHz P-III in Fall 2001, considering that it will be about as desirable as a Pentium 200MHz would be today. Graphics will also be a question mark. nVidia's custom chip is predicted to push out 1 trillion operations per second—that's phenomenal performance in early 2000, but by the time X-Box ships, PCs will likely surpass it. If anything, industry observers say, Microsoft didn't aim high enough with the X-Box.

"Two years from now, it's going to look very old," Enderle says.

Is it a PC?

X-Box may jazz up gamers, but it may also give shivers to PC OEMs wondering if it's a trojan horse to the PC market. With broadband connectivity, an x86-based OS, a hard drive, and HDTV support, X-Box is the perfect foil to Sony's PlayStation 2. It's widely expected that PlayStation 2 could post a threat to the PC as both a gaming platform and a means of browsing the web. By including DVD support and future plans for network connectivity, Sony had made it easy to turn the PS2 into a super set-top box that's used to access the Internet. The X-Box is Microsoft's answer to Sony, but in parrying the PS2, Microsoft stands to piss off the likes of Dell, Compaq, and Gateway, who also want a piece of the so-called information appliance market.

Microsoft officials dismiss the conspiracy theories, worried hardware partners, and general lip flapping as hogwash.

"It's a game console, not a PC," stresses Kevin Bachus. An evangelist for Microsoft's DirectX, Bachus says X-Box isn't a strategic move to block Sony from supplanting the PC. It's just going to be the best game console available with the best development tools around, he says.

During his GDC keynote, Gates himself admitted that Windows hasn't always been the most stable gaming platform. The same diversity that makes the PC so rich also makes it a coding nightmare. With dozens of choices in graphics, sound, control, processors, and OSes, game companies incur expensive technical consumer support problems and longer development cycles. X-Box is slated to address all this. With its locked-down hardware set and OS, X-Box will give developers a specific target to shoot for. And because it will be based on x86, DirectX 8, and a slimmed-down Windows 2000 kernel that's estimated to be kilobytes, not megabytes, game developers will be able to use the same tools they already use to make PC games. The Windows kernel will load from the game disc, so developers will have total control.

X-Box will mark a new business model for Microsoft in the game business. PC titles are now created without the need for licensing from Microsoft. With X-Box, Microsoft will adopt a console model similar to Nintendo's and Sony's, and require licensing to develop games. By doing this, Microsoft hopes to build in an extra level of quality control, and to reap the profits from licenses.

No Cannibals

One fear Microsoft officials say they don't have is cannibalizing the PC game market. Bachus says there's a clear difference between PC games and console games. Developers understand this and will not simply try porting every title they have to X-Box. And since the same basic tools will be used to develop both PC and X-Box games, the company doesn't expect developers to flee the PC for X-Box.

Likewise, Microsoft doesn't expect PC gamers to trade in their fast PCs for X-Boxes. Rather, X-Box's impact will be most felt on other console systems, such as Dreamcast, Nintendo's next-generation Dolphin console, and the PlayStation 2. ✹

	X-box	PlayStation 2	Performance PC 2002
CPU	600MHz+ P-III	300MHz MIPS	2GHz x86 compatible
GPU	300MHz nVidia X-Chip	150MHz Sony GS	350MHz
MEMORY	64MB DDR Unified Memory	38MB Direct Rambus	128MB DDR or Direct Rambus
STORAGE	8GB	memory card	500GB
OS	Win00 Kernel	N/A	Windows Millennium
RELEASE	Fall 2001	Fall 2000	Fall 2001
OTHER	USB, NIC, HDTV, DVD	IEEE-1394, PCMCIA	HDTV, USB 2.0, NIC, DVD, MPEG2 encoding, CD-RW, DVD+RW

to the pertinent details.

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
Sun Scientist Wants Tech Control	Bill Joy, one of Sun Microsystems' original founders, says the world is heading toward a technology-fueled disaster.	In an essay in *Wired* mag, Joy cites Unabomber Ted Kaczynski's manifesto against robotics, genetic engineering, and nanotechnology.	"We are being propelled into this new century with no plan, no control, no brakes," said Joy.	Our only chance is to send someone back in time to destroy Skynet before it gets out of control.
Cheetah Gets Longer Legs	Seagate has spun the fourth-generation Cheetah hard drive up to 15,000rpm.	The 15K drives will have from 4MB to 16MB of cache and use Ultra160 SCSI and Fibre Channel interfaces.	The Cheetah is expected to have 3.9ms seek time and cost less than $1,000.	Who said SCSI is dead?

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technology preview ► CPUs

Two Sides, Different Coin

Intel Strikes Back With 1.5GHz While VIA Aims Low

Intel is fuming. The chip giant, derisively called "Chipzilla" by some, is accustomed to owning the x86 CPU market in both clock speed and consumer mindshare.

That hasn't been the case since AMD introduced its Athlon chip and beat Intel to the release of 650MHz, 700MHz, 750MHz, and now 1GHz processors. Clock speed isn't the only thing that makes a proc fast, but it's practically the only number that consumers pay attention to.

AMD's winning streak may be coming to an end if Intel has its druthers. This February, Intel unwrapped a new CPU and gave it a mission: Terminate Athlon with extreme prejudice. Codenamed Willamette, Intel's seventh-generation 32-bit processor was demonstrated at 1.5GHz—500MHz faster than this month's spotlighted Athlon.

More significant than Willamette's clock speed is its actual core. Every Pentium II and Pentium III has been based on variations of the five-year-old P6 core introduced with the Pentium Pro. With Willamette (pronounced wil-LAM-it), Intel will adopt an entirely new IA32 architecture that includes:

WNI: A follow-up to the Katmai New Instructions (a.k.a. SSE) first introduced with Pentium III, 76 Willamette New Instructions will add to and enhance Willamette's floating-point and integer functions.

Think of VIA's Cyrix III as, umm, 2/5 of a GHz.

Double-pumped arithmetic logic units: Willamette's ALUs will transfer data on both the rising and falling edges of the clock. On the 1.5GHz PC that Intel showed off, the ALUs crunched math at a phenomenal 3GHz.

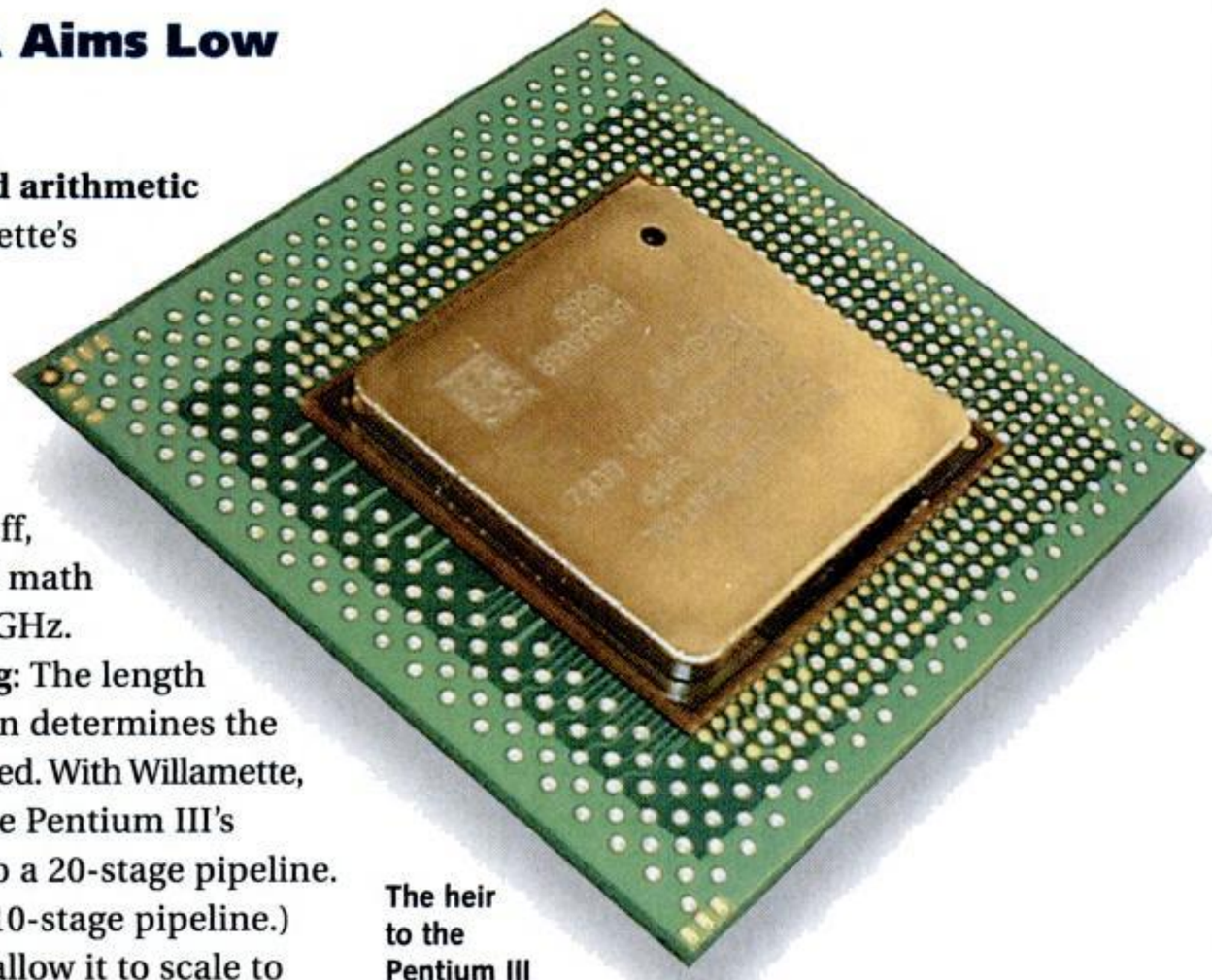
Hyperpipelining: The length of the pipeline often determines the maximum clock speed. With Willamette, Intel will double the Pentium III's 10-stage pipeline to a 20-stage pipeline. (Athlon features a 10-stage pipeline.) Intel says this will allow it to scale to superb clock speeds. Contrast that with VIA Technologies' new Cyrix III CPU, which uses a 7-stage pipeline and isn't expected to scale past 550MHz.

Quad-pumped bus: Willamette will use a 400MHz system bus (100MHz quad pumped). Intel says these speeds will mandate the use of dual-channel Direct RDRAM or Rambus memory. Dual-channel Rambus offers throughput of about 3.2GB/sec.

Intel officials say Willamette will run between two and three times faster than a 733MHz Pentium III, and that it can scale to incredibly high clock speeds. Intel will tie Willamette to its Tehama chipset and will likely move to a Socket 423 connector. Final pricing, clock speed, and availability details were not made public, but Willamette's release will surely be designed to derail the hot Athlon CPU.

At the other end of the power scale, VIA Technologies is preparing to release the Cyrix III chip. Based on the Joshua core (think biblical), the chip will be available in performance ratings of 500 and 533—that means clock speeds of 400MHz and 433MHz. The chips, expected to sell wholesale for less than $100, are aimed at the slew of cheap PCs that continue to pour out onto the market like an overflowing sewer.

VIA purchased Cyrix last year after Cyrix fell victim to the vicious price war between Intel and AMD in the low-end market. VIA has ambitious plans for its new CPU lineup. With its strong presence in PC chipsets and a major deal with S3 for graphics, analysts say Intel fears VIA Technologies more than AMD.



The heir to the Pentium III will be packaged solely in a socket.

VIA will exploit a license that Cyrix held with Intel to use the Cyrix III in a Socket 370 package. Several motherboard makers have already added support for Cyrix III. VIA will follow up Cyrix III with David and Samuel I (think biblical again).

The Cyrix IIIs will have a slight leg up on Intel's and AMD's bottom-feeder CPUs, as they will support bus speeds up to 133MHz and feature 64KB Level 1 cache and 256KB of full-speed L2. The L2 is also exclusive of L1, so Cyrix III will improve cache efficiency because it won't store instructions and data two times over. The Cyrix III will also offer support for the original 3Dnow! instructions.

People's appetite for Cyrix III may be short-lived in light of AMD's upcoming Spitfire CPU, which is based on Athlon, and Intel's Celeron, which is based on the 0.18 core. Machines using Cyrix III are expected to hit retail shelves in April, at ultra-low prices. ✹

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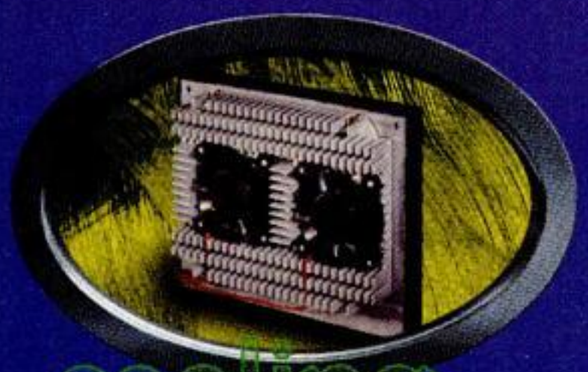

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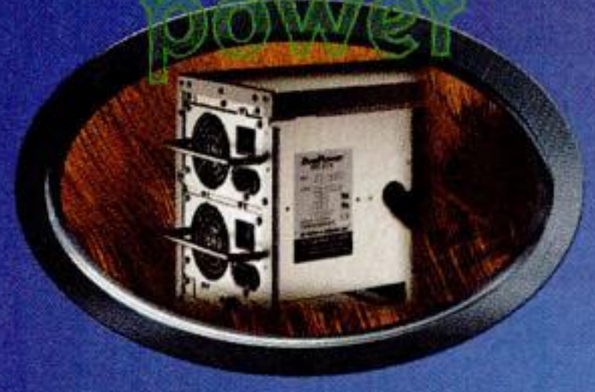

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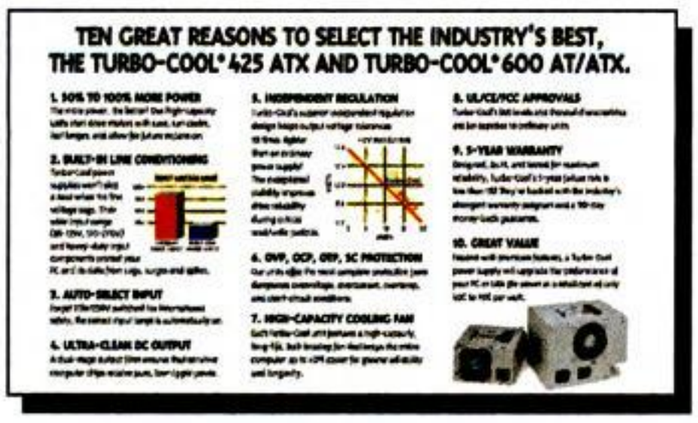

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ILLUSTRATION BY SCOTT LAUMANN

▶ Maximum PC takes a bite out of bad service and gear

WATCHDOG

Got a bone to pick with a vendor? Been spiked by a fly-by-night operation? Sic The Dog on them by writing **Watchdog @maximumpc.com**. The Dog promises to get to as many letters as possible, but only has four paws to work with.

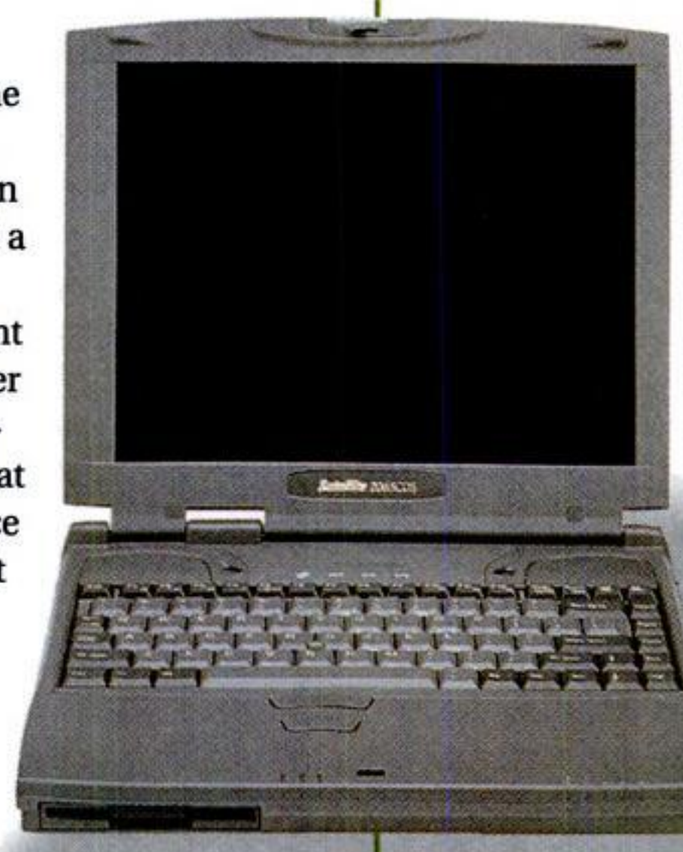
DOG EATS PORK

DEAR DOG: I ordered a notebook computer from Piggyback Delivery in British Columbia. Piggyback assured me the Toshiba 2060CDS I ordered was in stock in the warehouse. The salesperson told me the company had just received a shipment of them, and that mine would be shipped in 15 to 25 days. I sent Piggyback an international money order for $609, and received an e-mail thanking me for the order and confirming that the company would ship the item. Since then, the shipment has been delayed at least six times. The company said the reason for the delay was due to the volume of Piggyback orders.

After the fourth delay, I called expressing my concern that the company's offer seemed like an Internet scam to get the use of interest-free money. They vehemently denied this, saying the machine would be shipped in two weeks. That was in November. The company has since stopped responding to my e-mail.

I have tried everything I can think of to get some response from Piggyback, but no one will answer. I thought this was a fairly large company, but I have a strong feeling that this was some form of Internet scam carried out by several individuals within the company.

—Paul Smith



Too good to be true: a Toshiba for $600 Canadian.

THE DOG RESPONDS: Since contacting **THE DOG**, Smith received a refund with the help of local authorities. But the story doesn't end there for Piggyback. According to the local Better Business Bureau, Piggyback Delivery has had about a half dozen complaints filed against it by consumers, and has been linked with a not-so-virtuous company, Universal Computers of Vancouver.

In October, detectives with the financial crimes unit of the Vancouver Police Department raided the offices of Universal Computers after more than 150 Canadians complained to the Better Business Bureau that they had not received products from Universal. Complaints against Universal Computers were in fact so rampant, the BBB warned TV stations and newspapers not to run the company's ads. According to Valerie MacLean, general manager of the mainland British Columbia BBB, Universal shut its doors after the police raid.

Within a month of Universal's demise, the BBB began receiving complaints from Americans who claimed that Piggyback Delivery was not shipping products that had been ordered and paid for. One of Piggyback Delivery's principle officers identified herself as Tammey Wildbore—which happens to be the same surname held by one of Universal Computers' principal officers. The connection grew stronger when an American consumer complaining about Piggyback said that an e-mail he received about his problems with Piggyback had been sent from an address at Universal Computers. Huh?

Valerie MacLean recounted a happy ending to this sordid tale. She told **THE DOG** that Canadian government officials were able to freeze most of Universal's assets and send refunds to those who had placed orders and been denied products.

Vancouver police would still like to talk to you if were stung by Universal Computers. Contact the Vancouver Police Department at 604.717.2569, or e-mail detectives at vpd_fcu@city_vancouver.bc.ca. Those who think Piggyback Delivery bit them should contact the BBB at 604.682.2711.

"I have tried everything I can think of to get some response from Piggyback, but no one will answer."

The Dog offered Piggyback officials a chance to defend their position, but no one from the company responded to requests for an interview. The last time The Dog checked, Piggyback's voicemail system was full and its Web was page down. MacLean of the BBB says Piggyback denies any misconduct, and continues to operate.

Considering the tepid response the Dog received from the company, you can consider Piggyback Delivery of Kamloops, B.C., in the Dog House. Aroof.

NO UNREAL TOURNAMENT FOR YOU!

DEAR DOG: I recently purchased a 3dfx Voodoo3 3500. One of the main factors for selecting the V3 was the sticker on the box that said a free copy of *Unreal Tournament*

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would be included with the card. Unfortunately, the coupon I found in the box had an expiration date that had already passed. When I tried to confront 3dfx and GT Interactive about it, all I received was the message, "Sorry, but there's nothing we can do about it."

I find it quite ignorant for both of these companies to advertise bundled software after the offer has expired, and to refuse handing over what they promised after I've dished out my hard-earned cash. I guess this is a warning to all future Voodoo3 buyers. And don't expect me to run out and buy the Voodoo4 or Voodoo5 after getting burned like this.

—Tommy Cote

THE DOG RESPONDS: Ouch. C'mon, Tommy, how ya gonna survive without the motion blur and full scene anti-aliasing capabilities of the Voodoo5? **THE DOG** contacted 3dfx spokesman Brian Burke about the expired coupon problems. Here's the company's response:

"3dfx is aware that some users have recently purchased Voodoo3 cards that include an expired coupon for *Unreal Tournament*. 3dfx removed the coupon and sticker from our Voodoo3 boxes in October, but there may be some boxes that retailers still have in inventory. Retailers do not often sell product in a first-in, first-out method so more recent Voodoo3 product may have been sold before these older Voodoo3 boxes. 3dfx and GT Interactive are working closely together to help the customer. GT agreed to extend the offer deadline from Oct. 31, 1999 to Dec. 30, 1999. In conjunction with this extension, 3dfx placed an online coupon at our Web site detailing the new coupon deadlines. This allowed the retailers time to sell off excess inventory of the stickered Voodoo3 boxes. Yet for the very few Voodoo3 boxes still out there with the coupon, we're exploring ways to assist these customers. We hope to announce something very soon on the 3dfx web site."

Sounds fair. We'll keep an eye out for how 3dfx and GT Interactive solve this one, and let you know.

The coupons issued for *UT* on 3dfx cards have already expired.

"We recently learned from one of our vendors that AMS Tech had closed its doors."

AMS TECH NO MORE

DEAR DOG: I work for a small computer retailer that has sold several AMS Tech Roadster model notebooks over the past year. In the past, if a customer had a problem during the initial year of the manufacturer's warranty (AMS offered a three-year warranty) we would facilitate any RMA requests. Typically this has been no problem, but we recently learned from one of our vendors that AMS Tech has closed its doors. Fortunately, we received all computers we had submitted. Unfortunately, some had not been repaired. Is The Dog aware of the situation with AMS Tech, and is there anything that can be done to obtain warranty service for customers who have purchased the company's products?

—David Hamilton

THE DOG RESPONDS: AMS Tech, a.k.a. Associates Mega Systems, a.k.a. AMS Technology, is no more. After digging through dusty federal court databases, **THE DOG** discovered that AMS Tech filed for Chapter 11 protection from creditors in September 1999.

AMS Tech's main business was reselling Pac Rim notebooks and PCs to end users and stores. The company had racked up approximately $21.1 million in debts and about $10.7 million in assets when it filed for bankruptcy. In early March, creditors filed a motion to change the Chapter 11 to a Chapter 7 liquidation. At press time, the bankruptcy court had not yet ruled on the motion.

Those with warranties can file as creditors of AMS Tech, but the value of those warranties may not be worth much. Still, every attorney The Dog has ever spoken with says it's worth the postage stamp and the time. Claim form B-10 (available at www.uscourts.gov/bankform/formb10 new.pdf or at your local federal court) should be sent to the Clerk of the Court, U.S. Bankruptcy Court, Central District of California, 255 East Temple Street, Los Angeles, CA 90012.

It doesn't appear that AMS Tech actually manufactured the notebooks it sold. A check of the Jungle Notebook sites (www.lyngemark.com or www37.pair.com/lynge/jungle/jungle.html) shows that the AMS Tech, Soundwave, SoundPro, PowerCD, and TravelPro products were manufactured by Arima (www.arima.com.tw). The Dog also surmises that since Hitachi, Toshiba, Twinhead, and Mitac are creditors of AMS, they may have also sold notebooks to AMS. In fact, the AMS Roadster notebook appears to be nothing more than a re-badged Mitac 5000 series notebook. Consider contacting Mitac (www.mitac.com) for details on a repair service that may be able to help you with your Roadster.

HEADS UP ON MTRENDS AND CTX

Whaaazzup... Mtrends and CTX? Mtrends, a.k.a. Micro Trends of East Lake, Ohio, may be kicking it alone. Readers alerted **THE DOG** in March to the disappearance of Mtrends' web site.

Mtrends is no piker in Internet time. In fact, *boot* magazine, *Maximum PC's* predecessor, purchased parts from Mtrends to assemble the Dream Machine 97. Our calls to Mtrends weren't returned and its web site was inaccessible at press time. If you're out there, Mtrends, *Maximum PC* readers wanna know whazzup.

The Dog thought a similar fate had befallen CTX Computers of Walnut, California. When phone numbers published on its web site, www.ctxcomputers.com, were disconnected, readers thought CTX had died.

CTX officials tell The Dog they're just kicking it, having a Bud and watching the game, but with new phone numbers. The main number for CTX has been changed to 877.857.7846. Tech support (good luck getting any) is now ostensibly available at 800.888.2012. We should also note that CTX no longer appears to make PCs.

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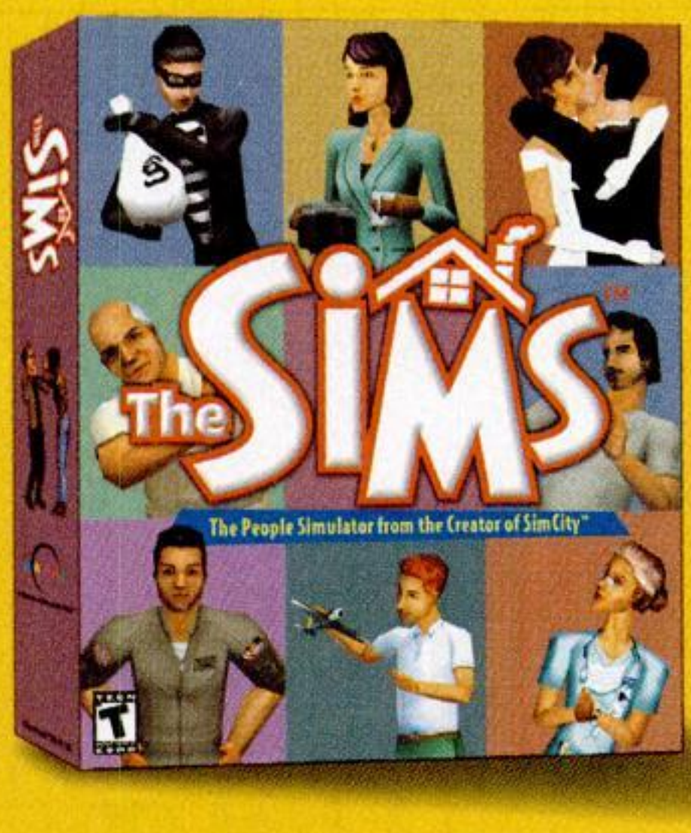

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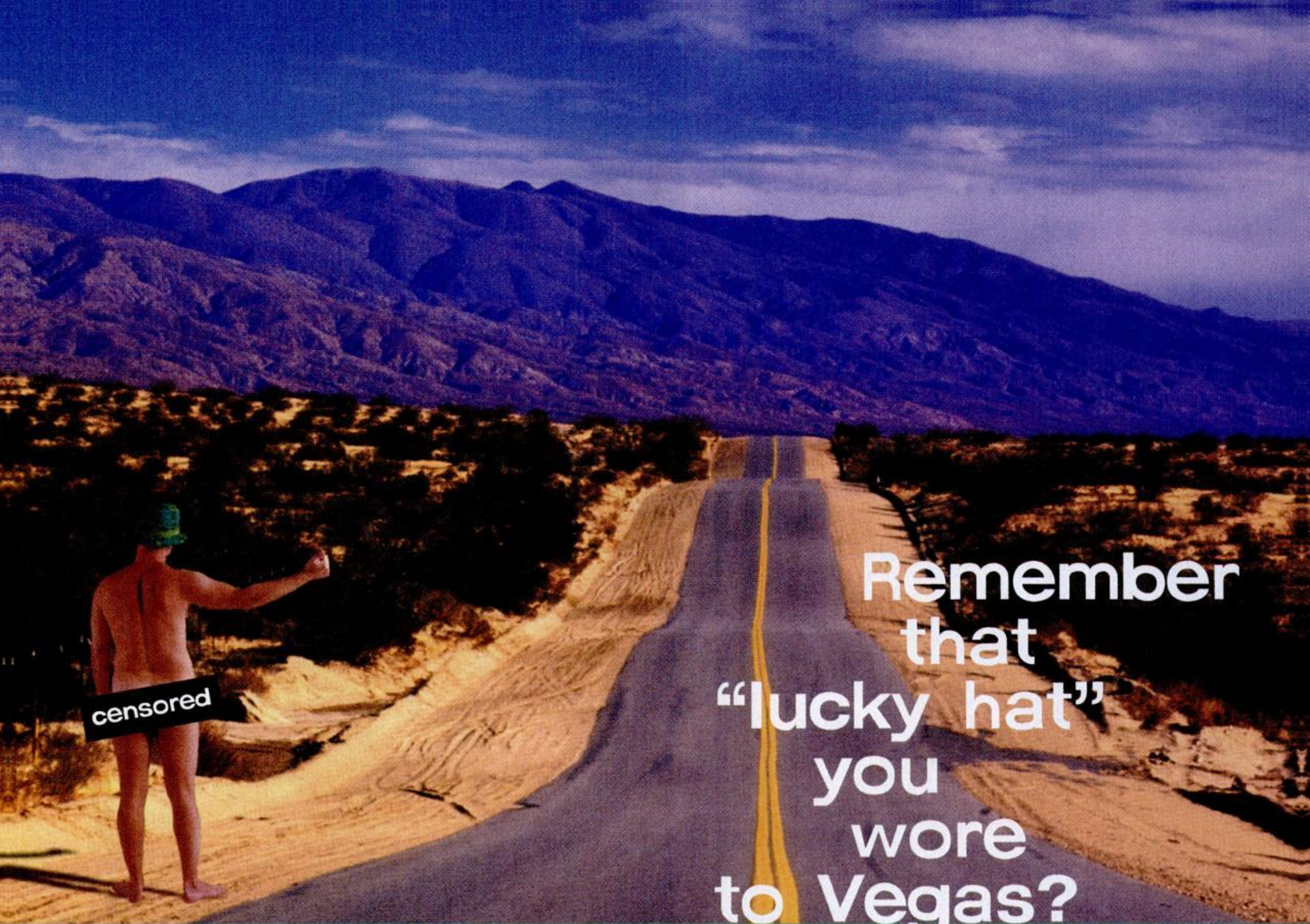

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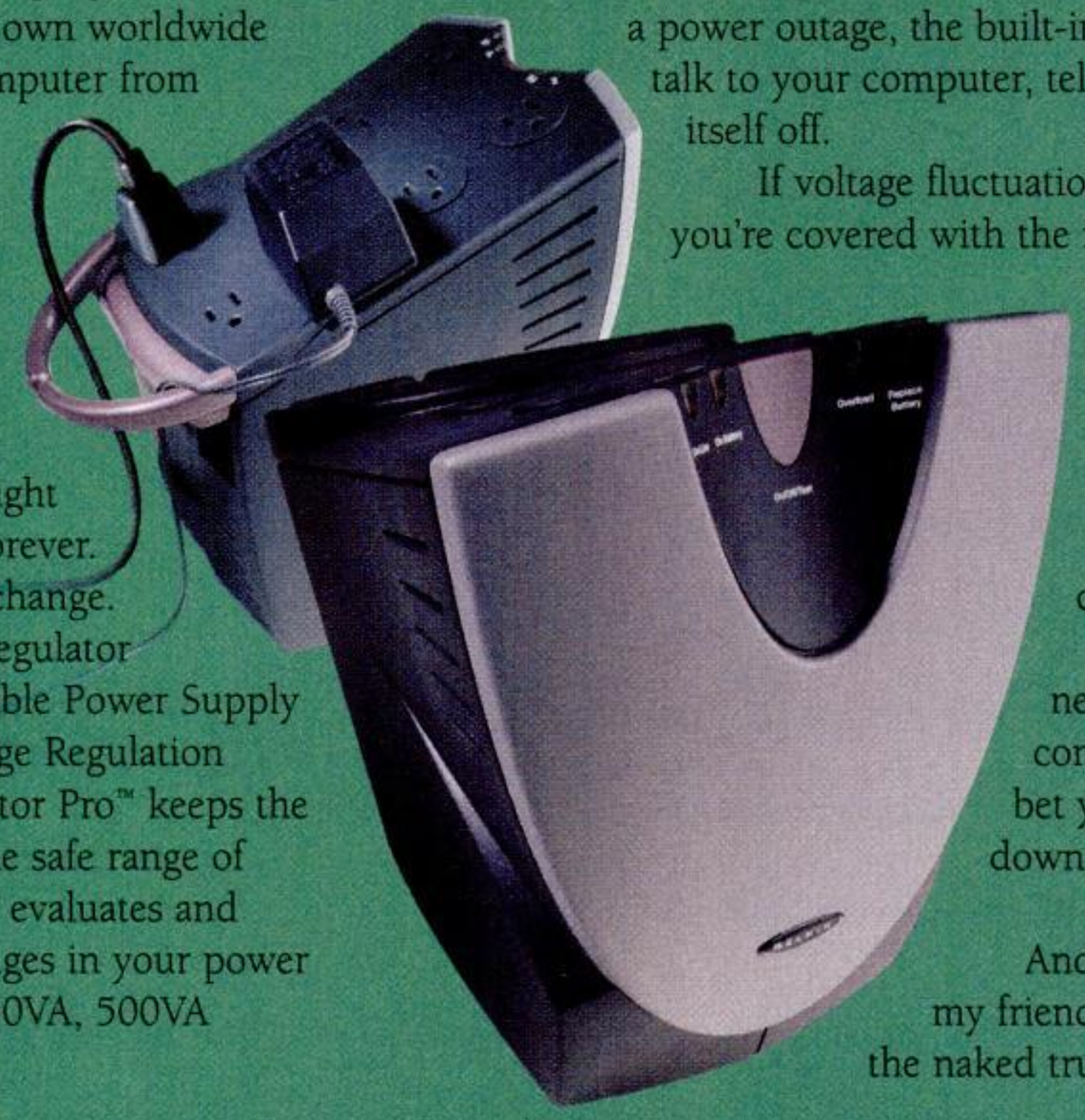

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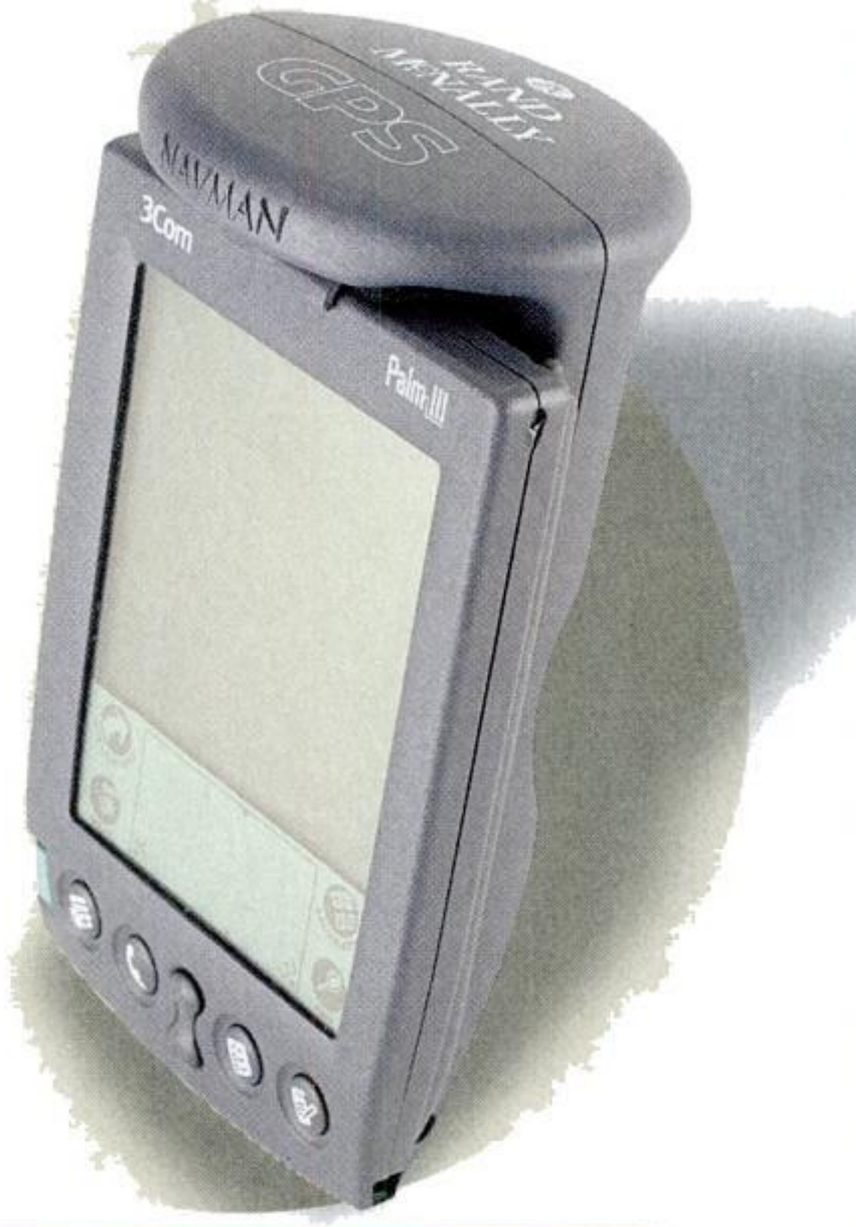

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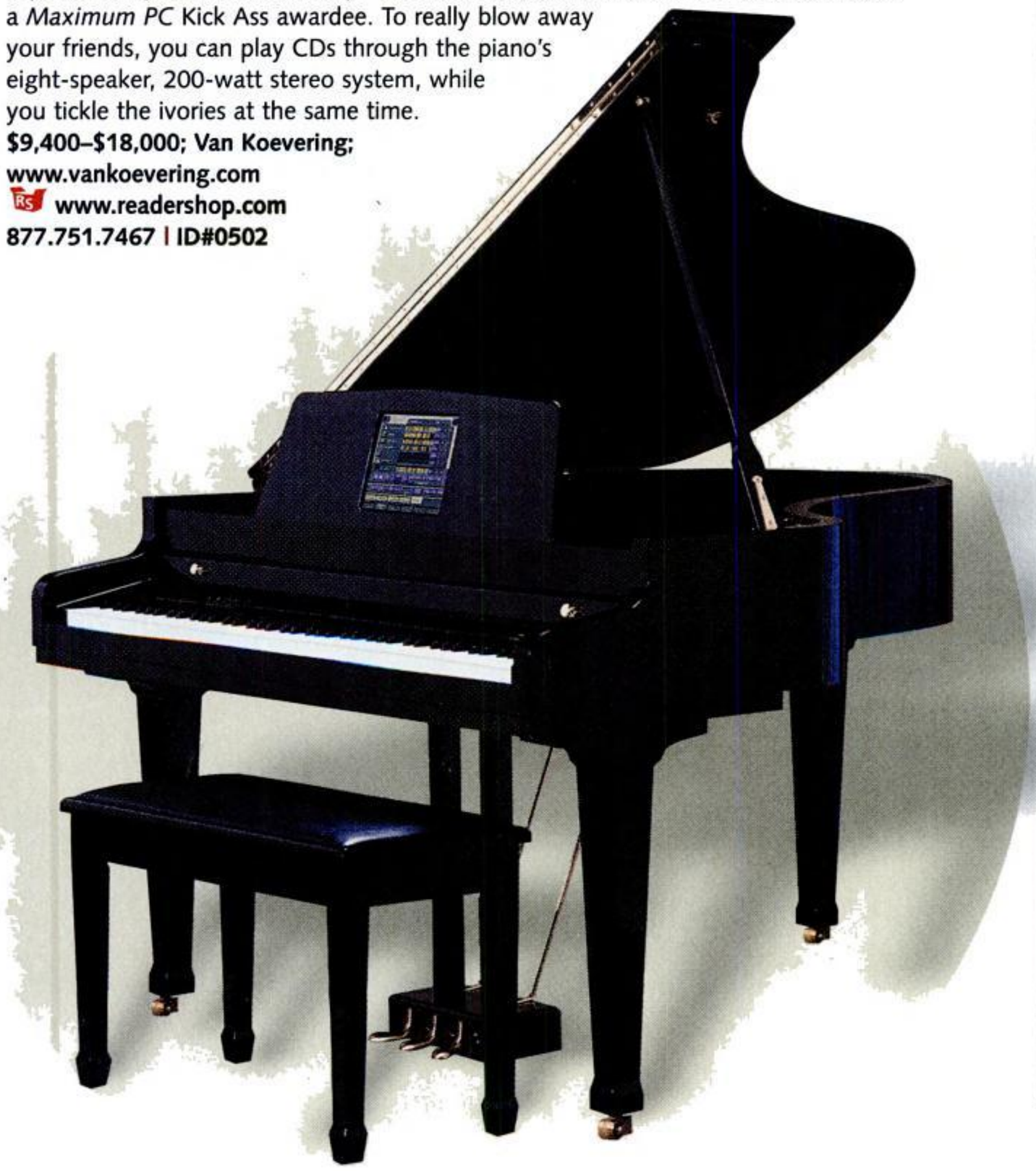

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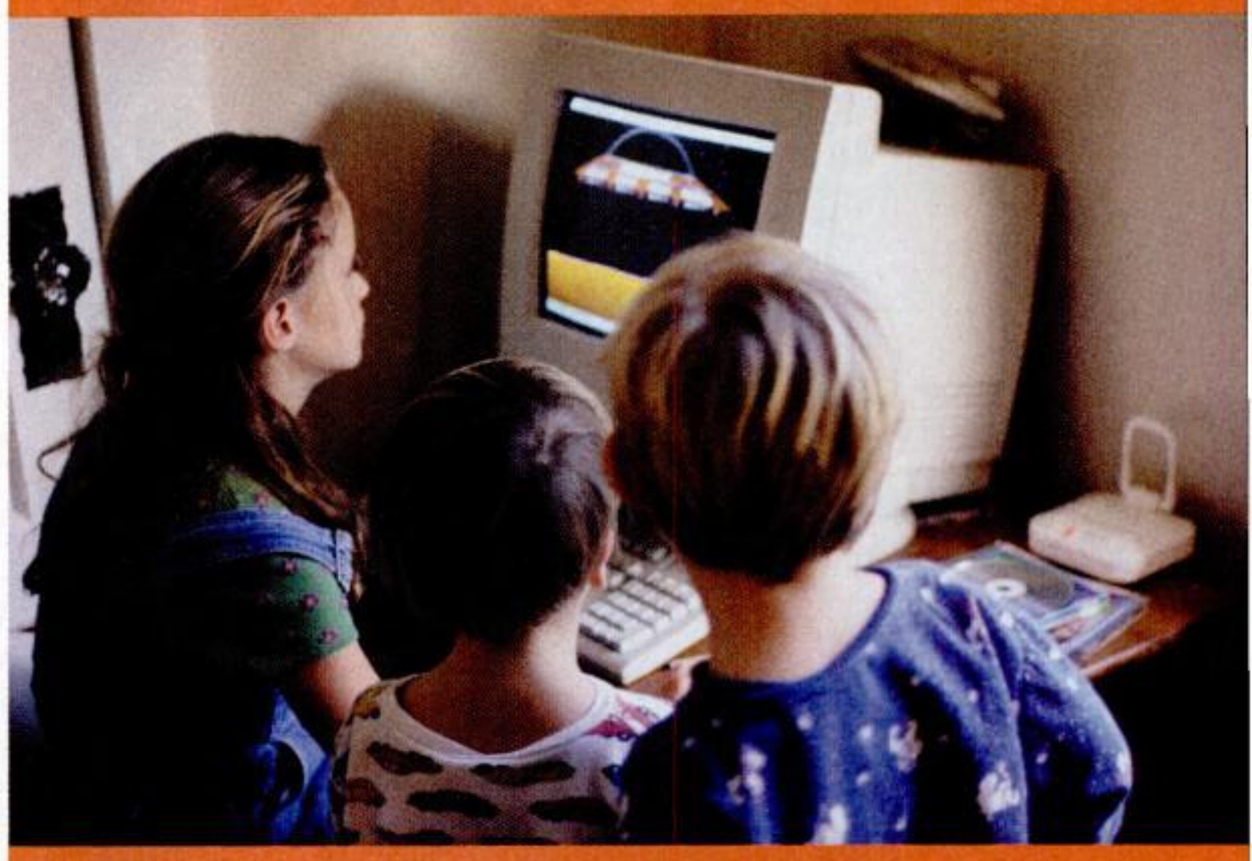

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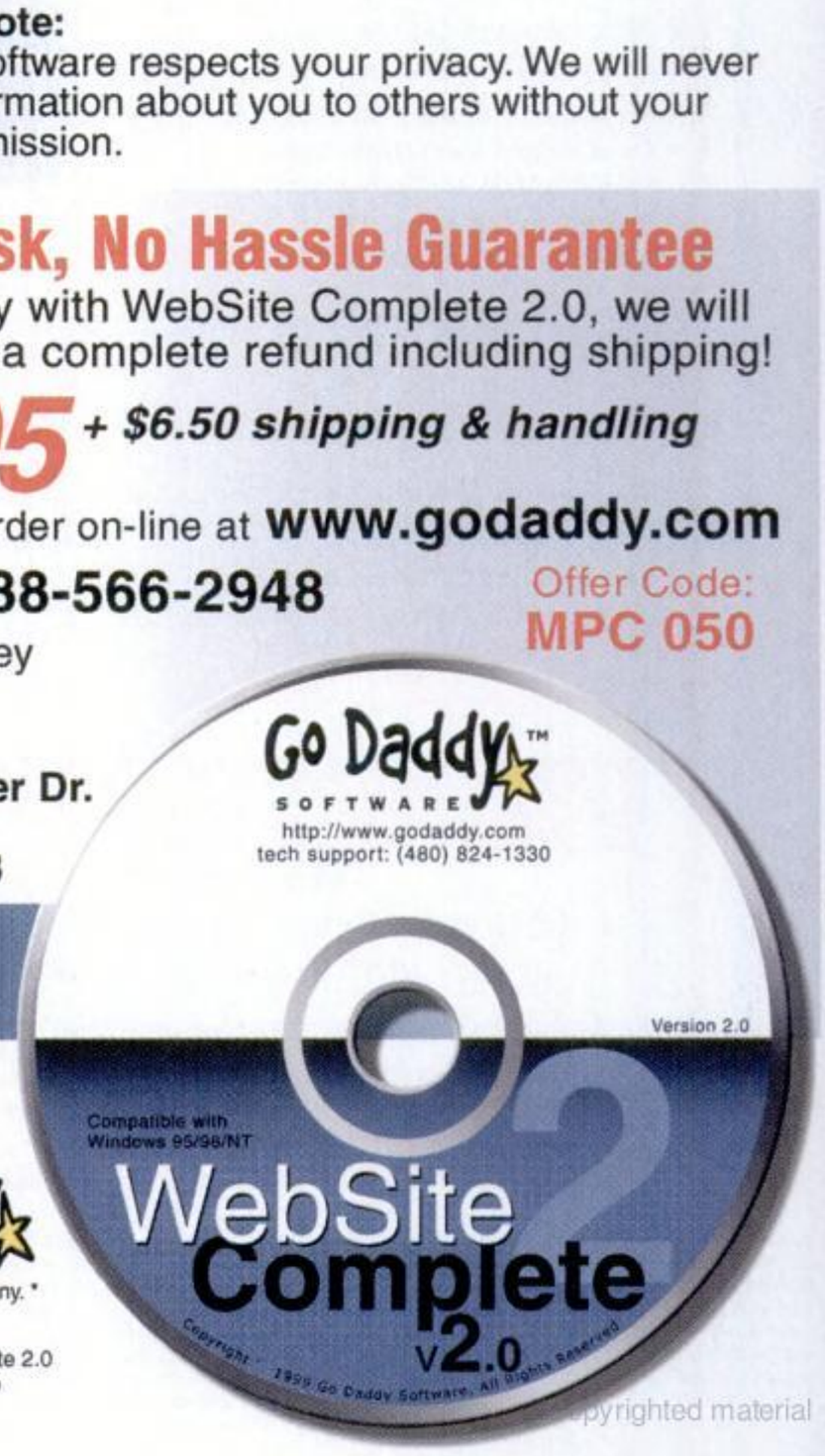

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▶TOMORROW'S TECHNOLOGIES EXPLAINED

FAST FORWARD

The Truth About Transmeta

IT'S EMULATION, BUT IT'S STILL COOL

Let's cut through the hype, which is thicker than the Pacific fog that rolls over Silicon Valley on winter mornings. Transmeta's "revolutionary" new Crusoe processors are actually proprietary VLIW chips with x86 software emulators. They aren't revolutionary, and they aren't nearly as fast as their clock speeds imply: According to Transmeta, a 700MHz Crusoe delivers about the same performance as a 500MHz Intel Pentium III.

But wait! Just because I'm trashing the hype doesn't mean I'm trashing the chips. Transmeta has employed some innovative technology in Crusoe, particularly for conserving power. Crusoe chips are perfect for notebook PCs because low power consumption means longer battery life and cooler operation. Just don't expect Crusoe to deliver the same performance as Pentium III or Athlon at the same clock speed.

There are two versions of Crusoe: the TM3120 and the TM5400. The TM3120 is for mobile information appliances that run a special version of Linux. The faster TM5400 is for Windows-compatible notebook PCs. Technically, these chips are not x86 processors like Pentium III or Athlon, because they cannot run x86 software on their own. They need Transmeta's "code-morphing software," which runs invisibly below the BIOS, operating system, and applications.

"Code morphing" is Transmeta's term for emulation. (If you need a refresher course in emulation, see "The Complete Guide to Game Emulators," *Maximum PC*, December 1999.) Sometimes it's also called dynamic binary recompilation, because the translator converts a program from one binary format (in this case, x86) into another (VLIW) while the program is running.

Transmeta's x86 emulator works on the same principles as other modern software emulators and the Java just-in-time (JIT) compilers built into Web browsers. One important difference is that Crusoe chips have special hardware features that improve the performance of x86 emulation. As a result, Crusoe should run x86 software faster than other emulators, such as *SoftWindows* and *Virtual PC* for the Mac.

Don't expect Crusoe to deliver the same performance as a Pentium III.

According to Transmeta, Crusoe consumes far less power than other x86-compatible processors with comparable performance—typically 1 or 2 watts, compared with about 15 watts for a 500MHz mobile Pentium III. Transmeta's claims are difficult to verify because battery-life benchmarks don't do a good enough job of simulating real-world use. But if the claims are anywhere close to accurate, Transmeta has a big advantage over Intel and AMD.

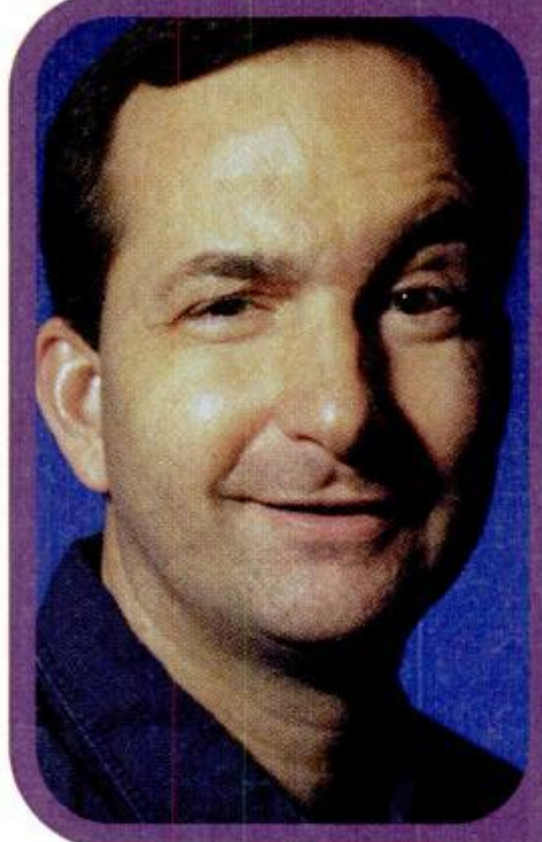
One way Crusoe conserves power involves a clever hardware/software feature called *LongRun*. The *LongRun* software continuously measures the amount of performance power a program requires and increases or decreases the processor's voltage and clock frequency in order to match those requirements. The processor automatically overclocks or underclocks itself in tune with actual software demands, without requiring you to change any jumpers, DIP switches, or BIOS settings! No other microprocessor has this capability.

Another secret of Crusoe's power conservation is VLIW (very long instruction words). There isn't room here for a detailed explanation of VLIW, but know that VLIW is the leading design philosophy for new microprocessors (Intel's IA-64 is based on VLIW). In general, VLIW chips have fewer transistors than comparable CISC or RISC chips, so they require less power.

One disadvantage of VLIW is that it requires better compilers. This is a special worry for Transmeta because its VLIW compiler is actually the emulator for Crusoe. An IA-64 compiler can run for hours, if necessary, to generate an efficient program. But Transmeta's emulator has to recompile x86 code into VLIW native code in microseconds, while the program is running.

Ordinary benchmark programs will have trouble accurately measuring Crusoe's performance. That's because the emulator keeps track of a program's behavior, noting which parts of the program execute more often. Instead of translating those parts over and over again, the emulator stores the translated code in a memory cache. This significantly improves performance, but also fools benchmark programs that rely on repetitive loops. The emulator will quickly recognize the repetition and cache all the loop code, so the benchmark will be unrealistically high.

Transmeta's emulator needs 16MB of RAM to work efficiently, so a notebook PC with 64MB of RAM will have only 48MB free for Windows and applications. Despite this, Transmeta has a real chance to lure business away from Intel and AMD in the notebook PC market. To match Crusoe's low power consumption, Intel and AMD would have to design completely new chips. Although Crusoe's performance may lag, its battery life is superior. A Crusoe notebook PC might outrun a Pentium III by a few hours. If Transmeta can deliver on its promise of "all-day computing," the lower performance will be worth the tradeoff. ✹



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▶ THE SCOOP FROM A MAJOR PLAYER

GAME THEORY

Mining the Budget Bin

DON'T LET ELITIST PRIDE KEEP YOU FROM KILLER GAMES

There's this unpleasant phenomenon in PC gaming (that I bemoan to the point of tedium) of consigning software to oblivion almost the instant it's published. Thousands of man-hours of work go into creating something that becomes old hat in a few months as publishers, retailers, and gamers move on to the Next Big Thing. This isn't unique to gaming; a rule of thumb in book publishing gives a new title three weeks to make its bones, or it's cut loose. Joe Lansdale's classic novel *The Drive-In* was pulped not long after publication because it didn't click quickly enough. Movies get about one week in theaters to bring in the bucks before they're shoved off to the video store.

Of course, examples of titles that build their reputations slowly mean little to the suits. Book publishing has its *Bridges of Madison County*. Film has its *The Full Monty*. Gaming has its *Panzer General*. Sadly, few games get the chance to demonstrate this slow build. If they get off to a slow start, it's likely that you'll find them in the wire rack before long.

Why give a company $40 for something you can get a few weeks later at less than half that price? Besides, nearly every game that's published is actually unfit for human consumption until a few months *after* it hits the street. With all the patching that goes on, some games are, frankly, unplayable before that. Why not wait, and pay less to get more?

But this is where things get tricky: If a large portion of the buying public adopted this attitude, they could conceivably wreck an already hurting format. PC game makers are already all atwitter from lagging sales and the console squeeze, so they spook easy. Still, this is a good time to look at the budget bin, as we lie hungover amidst the castoff *Sims* and *Quake III* boxes that litter the post-holiday wasteland of PC gaming.

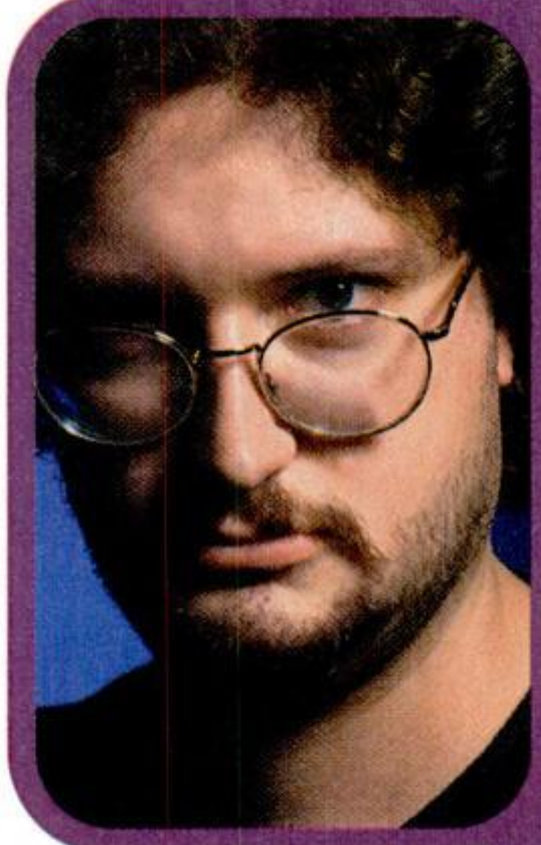
Chances are high that you, as a *Maximum PC* reader, are a hardcore power user who shuns the budget bin the same way a debutante shuns last year's gowns. There's this elitism that keeps your eyes averted when you pass the wire rack, just as we look away when we pass a homeless person on the street. "If they're in that bin, they must deserve it. They must have done something to wind up there." In fact, it's staggering to see what you can find for less than $10 or $15. There's more than just *Deer Hunter* knockoffs and copies of *163 Rockin' Solitaire Games*. Here's a small sampling: *Unreal* (no, really, I found it for $9.99), *Quake 2*, any version of *Tomb Raider*, *Fallout*, *Battlezone*, *Thief*, *Grand Theft Auto*, *Alien vs. Predator*, *Dark Reign*, *Civilization II*, *Panzer General II*, *Seven Kingdoms*, *Jagged Alliance 2*, *Warlords III*, *Total Annihilation Kingdoms*, and *WWII Fighters*.

Chances are high that you, as a Maximum PC reader, are a hardcore power user who shuns the budget bin the same way a debutante shuns last year's gowns.

Talonsoft's three *Great Battles* games can be had in one bundle for $3.99. Stretching the budget category to $19.99 more than doubles the number of titles, including über-bundles such as Bungie's *Myth Codex* (all the *Myth* games and add-ons, plus strategy guides), a *Fallout* compilation, and overlooked gems such as *Tribes*.

Any one of these games delivers more than much of what's selling for full price right now. The difference? Maybe the graphics aren't completely bleeding edge. The payoff? They probably work, since they've been patched to death. Plus, they're cheap. Many are better than their sequels. *Civ II* is light-years better than *Civilization: Test of Time*, and *Battlezone* holds up very well compared to the pretty but empty *Battlezone II*. Some gems were simply overlooked upon release, and never given a second chance. Not nearly enough people played *Thief* or *Seven Kingdoms*. Others, such as *Total Annihilation Kingdoms*, were initially slammed because they compared unfavorably with their predecessors, but at second glance, they turn out to be pretty decent games.

I wouldn't pine for *UT* or *The Sims* to hit the rack anytime soon. It's difficult to hear everyone talking about a hot title and not have it, particularly since the Internet makes us all like 10-year-olds on the playground, envious of the kid with the complete set of *Star Wars* figures (or *Pokemon* cards). But think about how many of those people jawing about a new game are bitching about bugs and system conflicts. It's no fun paying $50 to beta test, and there's no shame in shopping from the rack—even for a *Maximum PC* reader. ✹



T. LIAM MCDONALD is a veteran gamer and game writer. His reviews appear regularly in *PC Gamer* and other publications. Write him at **tmcdonald@maximumpc.com.**

Random Thoughts

▶ **X-Box:** Microsoft's entry in the console wars may shape up to be more than a sad attempt to muscle in on the hotly contested Sony/Sega turf. The early specs reveal a game-optimized super-PC that will provide convergence between the desktop and the set-top. Of course, Microsoft has a long, long road ahead to get this thing muscled through development, produced at a realistic price point, and into the homes of jittery consumers still reeling from the whole PSX2/Dreamcast brawl.

▶ **DirectThis, Bill:** Oh joy, a new set of APIs is on the way. At least DirectX 8 shouldn't play havoc with games the way some previous iterations did—we hope. The new drivers focus on sound and, according to MS, will deliver "motion-picture-quality interactive music and sound effects in games," as opposed to the armpit-farts and tin whistles we have now. More interesting will be improvements to DirectPlay, which will focus on scalable multiplayer architecture and integrated voice-over-net support.

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1GHz: The Athlon Has Landed

It's here and it's blowing our freaking minds.

The *Maximum PC* staff has waited more than three years for the momentous arrival. In early 1997, when we were just beginning to play with 200MHz Pentiums, we joked about the day when the 1GHz CPU barrier would be broken. "One gigahertz? Yeah, right. And is that a lemur or a marmoset flying out of my butt?"

It's now 2000, and the monkeys are flying at escape velocity. Our own personal flight path to 1GHz began the first week of this year, when we called Intel and AMD and challenged each manufacturer to send us a production-ready, air-cooled, 1GHz reference system for testing in our Lab. Both companies refused to say when their toys would be ready. We called again and again to extend the offer. Still no official word from either Santa Clara or Sunnyvale.

Then, in late February, a rather innocuous brown box arrived from AMD. Inside lay the object of our desire. The Athlon had landed.

It appears the race to 1GHz heated up furiously in the final stretch as AMD and Intel anguished over just the right time to pull their triggers. In fact, three times during late February, AMD moved forward its official announcement date—it was originally scheduled for March 30, but finally landed on March 6. Two days later, Intel announced its 1GHz Pentium III.

It's March 16 at the time of this writing. We have two 1GHz Athlon systems running in the Lab. We still haven't been able to score a 1GHz Pentium III from Intel or one of its OEM partners. Intel engineers invited us down to Santa Clara to benchmark one of their rare 1GHz procs in the Intel labs, but we prefer to test and tinker on home turf. Both AMD and Intel have surely had 1GHz CPUs bubbling away in their R&D shacks for quite a while, but we can confidently say that AMD has won the overall race to market. While AMD's partners now seem to be shipping 1GHz systems with ease, Intel's partners either have nothing to offer, or are receiving just token numbers of CPUs from Intel.

Posing as consumers 10 days after Intel made its 1GHz announcement, we called the toll-free numbers for Dell, HP, IBM, Micron, and Compaq, and tried to buy 1GHz P-III machines. Dell said it was taking pre-orders, but quantities were very limited. HP said it was receiving 100 procs per week. IBM said it would be getting 44 procs "in a week or two," but that 19 of them were already spoken for. Micron said it had no idea when its CPUs would arrive. Compaq said the 1GHz P-III is "not in existence."

Next month we hope to run 1GHz P-IIIs and Athlons head-to-head—and with the P-III's full-speed L2 cache, it could very well trounce AMD's best. But for now, enjoy our celebration of AMD's clock speed triumph. We'll show you how the Athlon got to 1GHz, how the latest speed compares to golden oldies, and what lies ahead.

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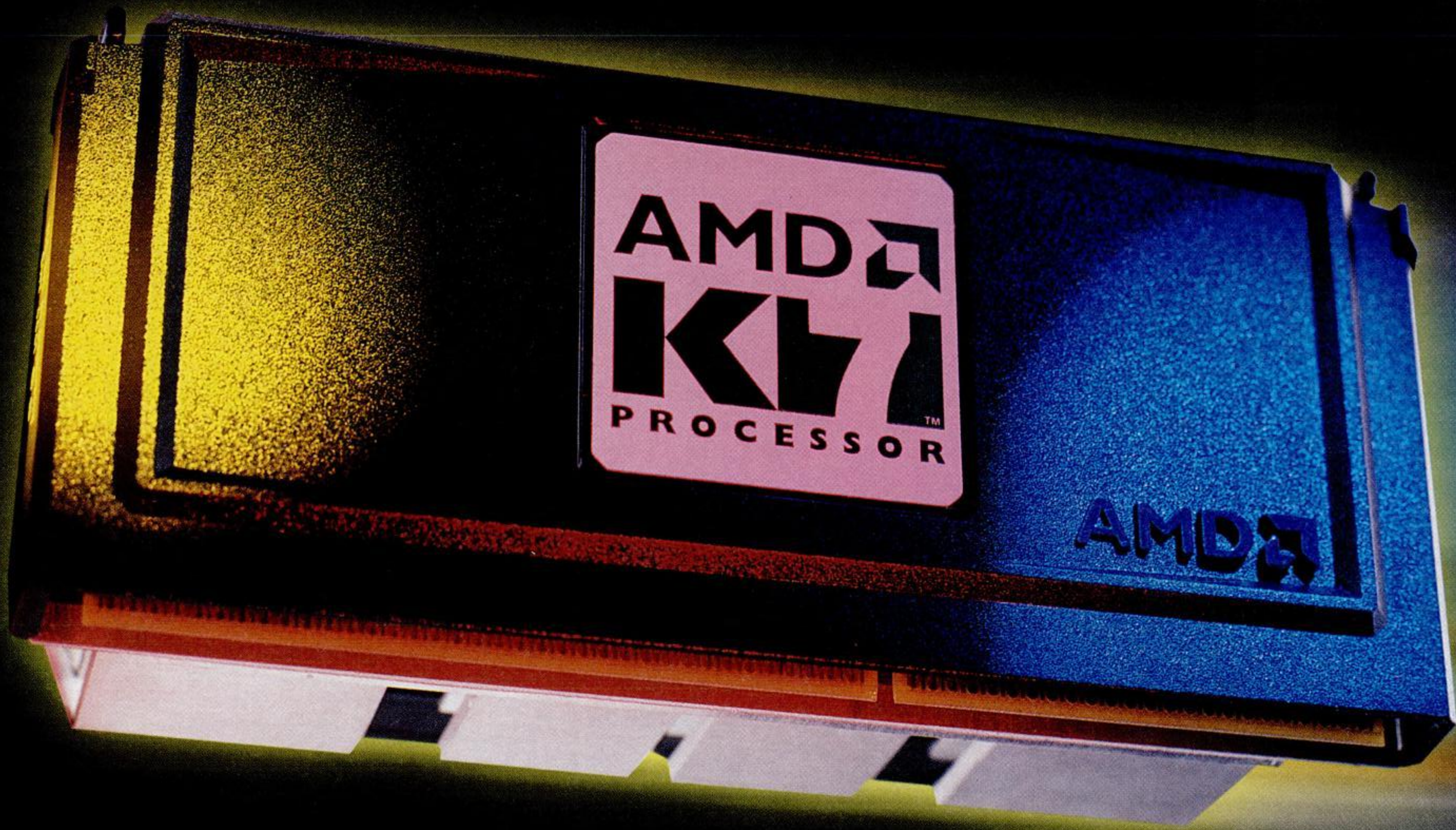

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The Flight to One Gigahertz

The world turned upside-down when IBM introduced the "IBM Personal Computer" in June 1979. That machine featured an 8MHz Intel 8088 processor based on 29,000 transistors and 3.0-micron technology. Now, 21 years later, the AMD Athlon runs at 1GHz, contains 22 million transistors, and is based on 0.18-micron technology.

We've come a long way, baby.

Herein we provide a chronology of every CPU speed breakthrough in the x86 processor family. In cases where several speed jumps were introduced in the same announcement, our chart simply reports the fastest speed announced. We should also note that new core architectures were sometimes introduced in CPUs with penultimate clock speeds; these engineering breakthroughs do not appear here.

The chart clearly illustrates that Intel owned the speed rackets until 1999. Now, with luxuriant processing technologies at their disposal, Intel and AMD are leap-frogging one another on the frequency front. More than ever before, faster speeds are introduced according to competitive marketing decisions, and one must assume that both Intel and AMD already have much faster CPUs running in their labs, but are withholding distribution until their fabrication facilities and OEM partners are ready to introduce the new speeds.

SUBSONIC

June '79	1	8 MHz Intel 8088
Feb '82	2	12 MHz Intel 286
Oct '85	3	16 MHz Intel 386
Feb '87	4	20 MHz Intel 386
April '88	5	25 MHz Intel 386
April '89	6	33 MHz Intel 386
June '91	7	50 MHz Intel 486
Aug '92	8	66 MHz Intel 486DX2
March '94	9	75 MHz Intel 486DX4

SUPERSONIC

March '94	10	100 MHz Intel Pentium
March '95	11	120 MHz Intel Pentium
June '95	12	133 MHz Intel Pentium
Nov '95	13	200 MHz Intel Pentium Pro
June '97	14	233 MHz Intel Pentium MMX

1000 MHz
950
900
850
800
750
700
650
600
550
500
450
400
350
300
250
200
150
100
50 MHz

1979 1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997

ILLUSTRATIONS BY XPLANE

ESCAPE VELOCITY

May '97	15	300 MHz Intel Pentium II
Jan '98	16	333 MHz Intel Pentium II
April '98	17	400 MHz Intel Pentium II
Aug '98	18	450 MHz Intel Pentium II
Feb '99	19	500 MHz Intel Pentium III
May '99	20	550 MHz Intel Pentium III
Aug '99	21	600 MHz Intel Pentium III
Aug '99	22	650 MHz AMD Athlon
Oct '99	23	700 MHz AMD Athlon
Oct '99	24	733 MHz Intel Pentium III
Nov '99	25	750 MHz AMD Athlon
Dec '99	26	800 MHz Intel Pentium III
Feb '00	27	850 MHz AMD Athlon
March '00	28	1 GHz AMD Athlon

How to Reach a Faster Clock

Two main factors determine a CPU's maximum clock speed: microarchitecture and process technology. Microarchitecture is the internal chip design. Process technology is the manufacturing method. These factors are closely related, and require CPU engineers to juggle many tradeoffs.

One popular way of achieving higher clock speeds is to employ a superpipelined microarchitecture. A pipeline is like a factory assembly line; it divides work into a sequence of stages. In a CPU, "work" is executing a program instruction (see page 44). Several instructions can move through a pipeline at the same time, with each instruction in a different state of completion. During each clock cycle, the CPU can retire the results of one instruction at the end of the pipeline while fetching a new instruction into the front of the pipeline.

Longer pipelines allow a chip to run faster because each stage has less-complicated circuitry. The time it takes for the slowest stage to do its work is the limiting factor for the whole pipeline, so dividing a slow, complicated stage into two or more simpler stages relieves the bottleneck. Pipelines with five to seven stages are typical, but more CPUs are using superpipelines with 10 or more stages. The Athlon has 10 stages.

Superpipelines have drawbacks, however. They are difficult to design, and branch instructions require the CPU to flush partially completed instructions out of the pipeline and replace them with new ones. (It's like a factory foreman suddenly ordering an assembly line to make pickup trucks instead of sedans—the partially completed sedans must be discarded.) To avoid this, modern CPUs try to predict the outcomes of branches. If the branch prediction stinks, superpipelining can actually hurt performance.

Process technology is important because it determines how fast a chip's circuits can operate. At smaller geometries (e.g., 0.18 microns is smaller than 0.25 microns), the circuits are packed more densely and the connecting wires are thinner. Smaller transistors switch faster; thinner wires have less electrical resistance; and electricity takes less time to travel over shorter circuits.

IBM and Motorola are now using copper instead of aluminum for the electrical connections in PowerPC chips. Copper is more conductive, so the circuits run faster. IBM is also pioneering a technology called silicon on insulator (SOI) that reduces capacitance, allowing transistors to switch faster.

Despite superior process technology, the fastest PowerPC G4 chip runs at only 500MHz. Why? Primarily because the G4 is handicapped by a short, five-stage pipeline. Yet the G4 is faster for some tasks than a much higher-clocked Pentium III or Athlon because of other microarchitectural differences. High clock speeds are sexy, but they don't tell the whole story.

-- Tom Halfhill

1998 1999 2000

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MHz, Oops, GHz Is Still King

If there's one thing AMD has proven, it's that clock speed is still king.

To put this into perspective, we pitted a 1GHz AMD reference system against two previously state-of-the art machines, one running at half a gigahertz, the other running at one-fifth a gigahertz. The half-giga had a 500MHz Pentium III Katmai on a 440BX mobo, 128MB of PC100 SDRAM, and a 32MB nVidia TNT2 videocard—a swank configuration circa 1999. We also reached farther back into computing history and dusted off a 200MHz Pentium MMX system. This 1997 screamer featured a whopping 96MB of 72-pin EDO memory, and an S3 Virge graphics controller coupled with the original 4MB 3dfx Voodoo card.

We pitted a 1GHz AMD reference system against two previously state-of-the art machines.

Keep in mind that our comparative testing was a matter of apples-to-oranges-to-kumquats. Each machine boasted markedly different videocards, chipsets, memory, and storage systems. Still, our benchmarks show just how far "elite systems" have improved in a few short years.

Using the *bootMark*, which stresses integer, cache, and chipset performance, we found that the 1GHz CPU scaled better than expected. In almost every *bootMark* run, it tested nearly 100 percent faster than the 500MHz box. However, while conventional wisdom would dictate that a 1GHz PC would be only five times faster than a 200MHz PC, the 1GHz *bootMark* score was nearly 12 times that of the 200MHz. In fact, the 1GHz box ran from five to nine times faster than the 200MHz system in almost all our tests.

To contrast performance among the three machines, we used a bevy of benchmarks. *Quake III Arena* obviously won't run on a vanilla Voodoo card, and that's why you won't find a 200MHz score in the chart below. But *QIII* does run on a TNT card, and its scores demonstrate a nearly 100 percent improvement from 500MHz to 1,000MHz (we lowered the resolution to 640x480 in order to better isolate CPU performance). Likewise, *Expendable*, showed a vast improvement from 500MHz to 1GHz.

We also compared the 1GHz reference box to this month's 1GHz Compaq Presario (reviewed on page 74). With the aid of VC133 memory clocking 33MHz faster than the Compaq's PC100 memory, the AMD reference box beat the OEM box in almost every test.

While testing Athlons over the past few months, we've noticed an unsettling pattern with CPUs as they've progressively increased in clock speed: Overall performance doesn't seem to keep pace with the ever-increasing speeds. We place the blame on lagging L2 cache.

Athlons currently use 512K of L2 cache that resides in a discrete SRAM chip. The chip shares a daughtercard with the CPU die. With all Athlons clocked up to 700MHz, the L2 runs at half-speed—350MHz on 700MHz CPUs. With the 800MHz Athlon, the L2 drops to two-fifths of the overall speed—320MHz. On the 1GHz, the L2 runs at 333MHz, or one-third of the overall clock speed. The fact of the matter is, today's discrete SRAM chips can't comfortably run faster than 350MHz, so AMD must clock them down when pairing them up with its fastest CPUs.

AMD knows that expensive, slow, off-die L2 cache will continue to hurt the Athlon's performance. In a toe-to-toe imbroglio, we fully expect 1GHz Pentium IIIs, with their 256K of full-speed, on-die L2 cache, to whomp the 1GHz Athlon in many benchmarks. AMD will address the L2 cache dilemma with the next version of Athlon, code-named Thunderbird.

So the 1GHz machine benchmarked quickly, but how did it *feel*? Actually, it made the 500MHz system feel dog-ass slow. General futzing and running *Drive Image* to restore a hard drive became infuriating when we slowed down from 1GHz to 500MHz. If you're tired of waiting, maybe it's time to toss that 6-month-old system.

If you're wondering whether its time to upgrade from a 200MHz box, stop—there's no question that it is. In fact, your 200MHz PC is stealing your life from you. Every *Outlook* search that takes five minutes to complete, and every *Photoshop* filter that takes two or three minutes to run, are comprised of moments in life you'll never get back.

It's easy to look at these numbers and think 1GHz is overkill. The truth is, 1GHz isn't enough. We haven't realized science fiction yet. We don't yet have talking computers á la *Star Trek* and apps aren't whizzing by at warp speeds. We need more power, but we'll settle for 1GHz for now.

—Gordon Mah Ung

MANUFACTURER	REFERENCE	COMPAQ	DELL	HP
CPU	1GHz Athlon	1GHz Athlon	500MHz P-III Katmai	200MHz Pentium MMX
Chipset	VIA KX133	AMD 750	Intel 440BX	Intel 430HX
Videocard	32MB DDR nVidia GeForce AGP Pro	32MB nVidia DDR GeForce AGP	32MB nVidia TNT2	2MB S3 Virge/4MB 3dfx Voodoo
RAM	256MB VC133 SDRAM	256MB PC100 SDRAM	128MB PC100 SDRAM	96MB EDO RAM
*SYSmark*2000	182	170	107	30
*3DMark*2000 CPUMarks	314	287	175	wouldn't run
bootMark	452.7	436	235	38.5
Quake III Arena 1024x768x32	48fps	48fps	22fps	wouldn't run
Quake III Arena 640x480x32	77fps	72fps	32fps	wouldn't run
Expendable 512x384x16	91.5fps	87.6fps	56.5fps	12.8 fps
Inspire 3D	265 sec	258 sec	435 sec	1559 sec
*MusicMatch MP*3 Encoding From WAV	70 sec	74 sec	144 sec	535 sec
Photoshop 5.5	146 sec	154 sec	247 sec	917 sec

Testing Notes: *SYSmark*, *3DMark*, and *bootMark* report scores based on their own synthetic scales; higher scores are better. *Quake III* and *Expendable* report actual frame rates; higher scores are better. *Inspire*, *MusicMatch*, and *Photoshop* run our own homemade scripts; scores are reported in seconds to complete; lower scores are better.

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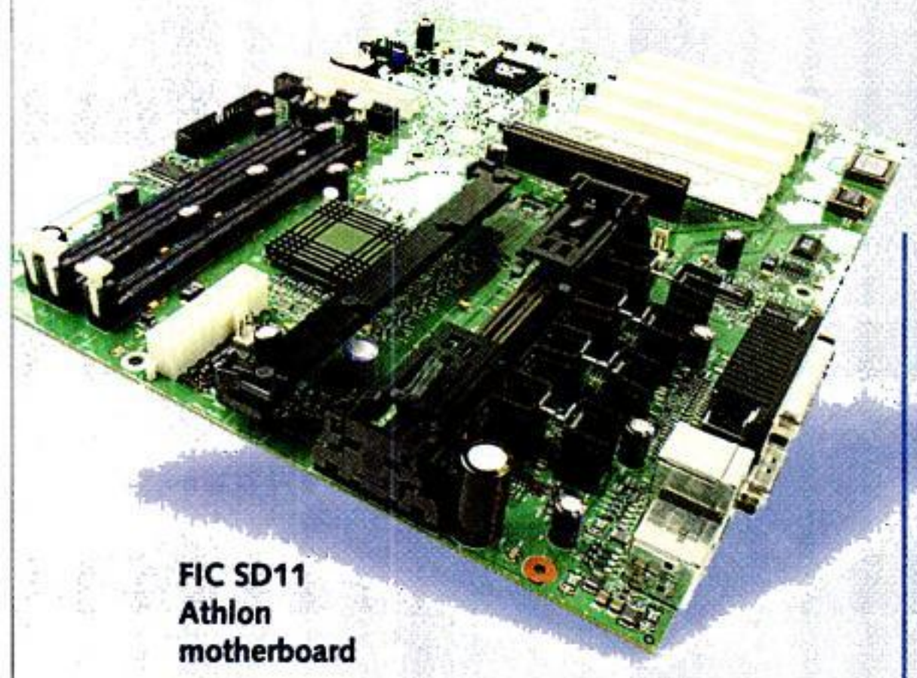


FIC SD11 Athlon motherboard

How to Cope With Athlon Woes

Kickin' it in the *Maximum PC* Lab, an editor from an Imagine Media gaming magazine related his own Athlon system-building horror story: mysterious crashes, blue screens, and memory problems. The end result? The editor bought a Pentium III Coppermine and VIA Apollo Pro 133A motherboard, and has been smiling ever since. What the feck happened? We thought AMD had banished its evil compatibility problems when it graduated from Super 7.

Although AMD says the Athlon is a stable, reliable platform, there's no arguing with hobbyists who've hit brick walls. Does this mean the Athlon is a wicked pissa of a proc? Nope. We've assembled our own Athlon systems from scratch without problems. But we can tell you that you shouldn't approach an Athlon project with the same cavalier attitude that you might approach a P-III project. In fact, if you've never built a box before, you may want to stick with a Pentium III and BX-based motherboard. But if you're game...

▶ Buy a power supply from AMD's "approved" power supply list. The Athlon is a gas guzzler, so you'll need a high-quality power supply to feed it the juice (0.25-micron Athlons can be extra sensitive). If you're wondering how the hell you can buy a power supply by itself, consider ordering it from vendors like PC Power and Cooling, which specifically serve hobbyists. The company's Turbo-Cool 300 is on the AMD list, and the company's rep is first rate.

▶ Use brand-name memory from such vendors as Crucial Technology and Corsair; reusing generic DIMMs will just break your heart. Check your mobo maker's web site to see which memory has been approved. When following memory installation directions, remember that the first DIMM slot on some Athlon boards is the one *furthest away* from the CPU.

▶ Consider your cooling situation, because horsepower doesn't come without a price. Athlons based on 0.25-micron technology get hot enough to grill on, and 1GHz puppies use dual high-speed fans attached to the biggest heatsinks we've ever seen. Be sure your case has plenty of ventilation.

▶ AMD's original 750 chipset seems to be a moving target, so stay on top of BIOS updates from your mobo manufacturer. They could correct any problems you might encounter.

▶ Early Athlon motherboards had problems with SCSI adapters. If you're trying to build a SCSI rig and you're ready to poke your eyes out because you can't figure out what's going wrong, try running pure IDE to see if SCSI is your problem.

▶ Read the FAQ at your motherboard maker's Web site; it may address such issues as problems with SCSI cards. Again, a BIOS flash may be in order.

▶ Chip pirates who once re-marked slow Pentium II chips and sold them at higher prices have now moved on to Athlons. While it's not known how extensive this problem is, some reports indicate these low-life scumbags may be ripping off Athlon fans.

▶ Watch those rev numbers. Early Athlon motherboards (as well as Pentium III boards) have been updated and updated again. Some of the fixes by motherboard manufacturers can only be done in hardware. Before you buy an Athlon board, find out how to tell the difference in revision numbers, and opt for the latest rev.

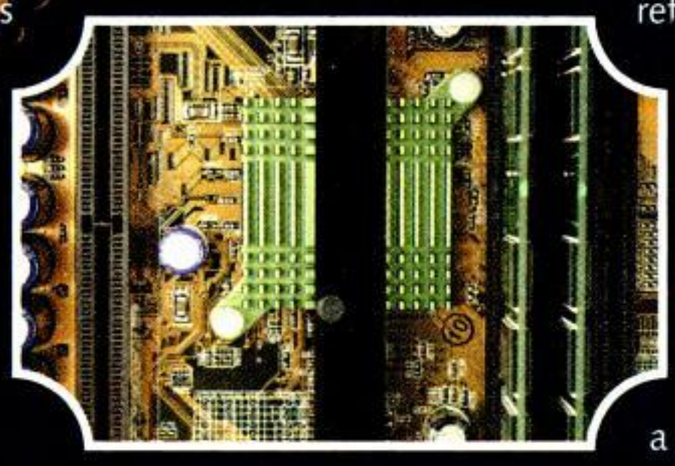
▶ Don't overclock your brand new Athlon system. Just as you wouldn't tach your brand new car to redline, you shouldn't stress out your Athlon until you've broken it in and ensured it's roadworthy. Once you're confident that it's running reliably, then you can rip the CPU cartridge open and overclock your heart out.

—Gordon Mah Ung

KX133 Chipset Ups the Athlon Ante

Stuffed inside the AMD reference box was something almost as exciting as the 1GHz Athlon: VIA Technologies' highly anticipated KX133 chipset in an Asus motherboard. The KX133 gives the Athlon crowd important features that are unavailable in AMD's own AMD 750 chipset. The KX133's most prominent feature is support for AGP 4x. The AMD 750, which powers most Athlons today, supports just AGP 2x. The KX133 also trumps the AMD 750 by supporting 133MHz memory. The Athlon's point-to-point EV6 bus actually runs at 200MHz, but 133MHz memory greatly reduces latency from RAM to CPU. The KX133 also lets you use VC133 memory in addition to PC133. Virtual Channel memory uses a tiny bit of super-fast SRAM to act as a data buffer, further improving speed.

The KX133 chipset also lets manufacturers create motherboards using a four-layer process, instead of the more expensive six-layer process that the AMD 750 required. This will greatly reduce the price of mobos, which means building Athlon systems from scratch will be a cheaper proposition. All of the KX133's fresh goodness can be found in its northbridge chip. To test AGP performance differences between the KX133 and AMD 750 northbridge chips, we ran *3DMark2000* on both our 1GHz AMD reference box and the Compaq 1GHz Presario reviewed on page 74. The differences were astounding. The reference box's KX133 scored 404 points above the Compaq's *3DMarks*. We used *3DMark2000*'s texturing test to pass 32-bit, 32MB textures across the AGP bus. While the Compaq hit 210fps, the reference box achieved 261.2fps.



VIA's chipset gives Athlon AGP 4x and PC133 support.

Right now, almost every mobo vendor is preparing KX133 boards, and of vendors we queried, all were in the final stage of quality-assurance testing. We still haven't banged on a KX133 board directly from a mobo vendor, but we like what we found in the AMD reference system. The KX133 definitely seems worth waiting for.

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22 Nanoseconds in the Life of a CPU

How an instruction winds through the Athlon

BY JON STOKES

When it comes down to it, all a CPU really does is rearrange and add up binary numbers. All the other arithmetic functions—such as division, multiplication, or computing square roots—are implemented via a very fast series of bit shifts and additions. Turning instructions that specify high-level operations into simple steps that the CPU can handle quickly is a long and complicated process. A close look at the die of AMD's Athlon hints at the complexity of the hardware needed to wring the last drop of performance from today's x86 application code. Buffers, control units, caches, execution units, and other components all work together to the beat of a 1GHz pulse, pushing instructions and data through the Athlon as fast as possible.

In order to process instructions quickly, the Athlon divides the execution of each instruction into various stages. These stages, taken together, are called the pipeline. The Athlon moves instructions through the pipeline's stages like cars through an assembly line—except that in the Athlon's case, the pipeline is more of a "disassembly line." Since the Athlon's insides can't process the large, unwieldy x86 instructions, it uses a two-stage digestion process to break them down before actually crunching them.

The first stage of this process is the "early decode" stage, in which Athlon translates the x86 instructions into a special, internal instruction format called a MacroOP—a RISC-like instruction that the Athlon uses for scheduling and tracking purposes. x86 instructions aren't uniform in size or functionality, so by breaking them down into uniform, easily managed MacroOPs, the Athlon can move them around and keep track of them much more efficiently.

In the early decode stage, there are two possible paths an x86 instruction can take on its way to becoming a MacroOP. The first path, called the DirectPath, is taken by the smaller and more uniformly sized of a program's x86 instructions. Each x86 instruction that is DirectPath-decoded is turned into exactly one MacroOP, making the DirectPath the most efficient and optimal decoding path. Modern x86 compilers know that these shorter instructions are best, so the majority of the x86 instructions that the Athlon encounters are DirectPath-decodable. The second decode path is the VectorPath. This is the path taken by more unwieldy x86 instructions. VectorPath instructions are decoded by a microcode engine, and usually decode into more than one MacroOP.

Once an instruction becomes a MacroOP, it can be scheduled for execution. It can't, however, be executed. In order for the Athlon's execution units to actually execute the MacroOP, the MacroOP must enter a "final decode" stage, where it is further broken down into an even smaller instruction format called an OP. Each MacroOP breaks down into either memory access OPs or regular instruction OPs such as add, multiply, and divide calculations. It is the OP that the Athlon's Floating-Point and Integer Execution Units actually execute.

To get a clearer understanding of how this works, we tracked a floating-point addition instruction—FADD st(0), st(1)—through the Athlon's insides. But before we actually describe the instruction's path through the CPU, we should get more acquainted with the instruction's basic format.

In the instruction "FADD st(0), st(1)," the term to the far left, "FADD," specifies that the operation to be performed is a floating-point addition. The second two terms, "st(0)" and "st(1)," tell the Athlon which registers contain the two numbers to be added. The registers' job is to hold, in an easily accessible spot, both the data on which operations are performed and the results of those operations. Think of registers as pieces of scrap paper on which the CPU temporarily records the numbers it's currently working with. Our FADD instruction takes whatever values are currently held in registers st(0) and st(1), adds them together, and places the result in st(0). Whatever number was previously stored in st(0) gets overwritten.

In the following seven steps, we'll track our FADD as it makes its way from RAM down to the Floating-Point Execution Units. It'll first stop off in the L1 cache, and from there it'll make its way into the early decode stage. After it has been early decoded, it will enter the ICU so it can be dispatched to the FPU, where it will finally be executed.

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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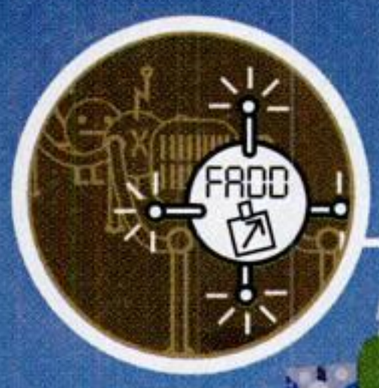
The early-decode hardware (EDEC) is where our FADD finally changes from an x86 instruction into a MacroOP. As noted above, the FADD is one of those short, uniform x86 instructions that the Athlon likes. Since it's a short instruction, it makes its way through the DirectPath decoding hardware, and emerges on the other end as a MacroOP.

4 15 NANOSECONDS

Now in a form that the Athlon's insides can digest, the FADD moves on to the Instruction Control Unit. As the brains of the Athlon, the ICU uses a 72-entry buffer to track up to 72 MacroOPs as they thread their way through the rest of the CPU. The fact that the Athlon employs such advanced performance-enhancing techniques as pipelining, superscalar execution, and out-of-order execution means that at any given moment, there are about 72 different instructions inside the CPU. These instructions will be in various stages of execution, and are each being rearranged to execute in parallel and/or out of program order. The thankless task of keeping track of all this craziness falls on the ICU. It's at the ICU that our MacroOP FADD, as a floating-point operation, diverges from its integer operation peers. The Integer operations head off to the Integer Scheduler and eventually wind up in the Integer Execution Unit, where they're actually executed (a grisly sounding prospect in light of the graduation analogy). The MacroOP FADD, however, travels on to the next-to-last stop on its journey, the Floating-Point Scheduler.

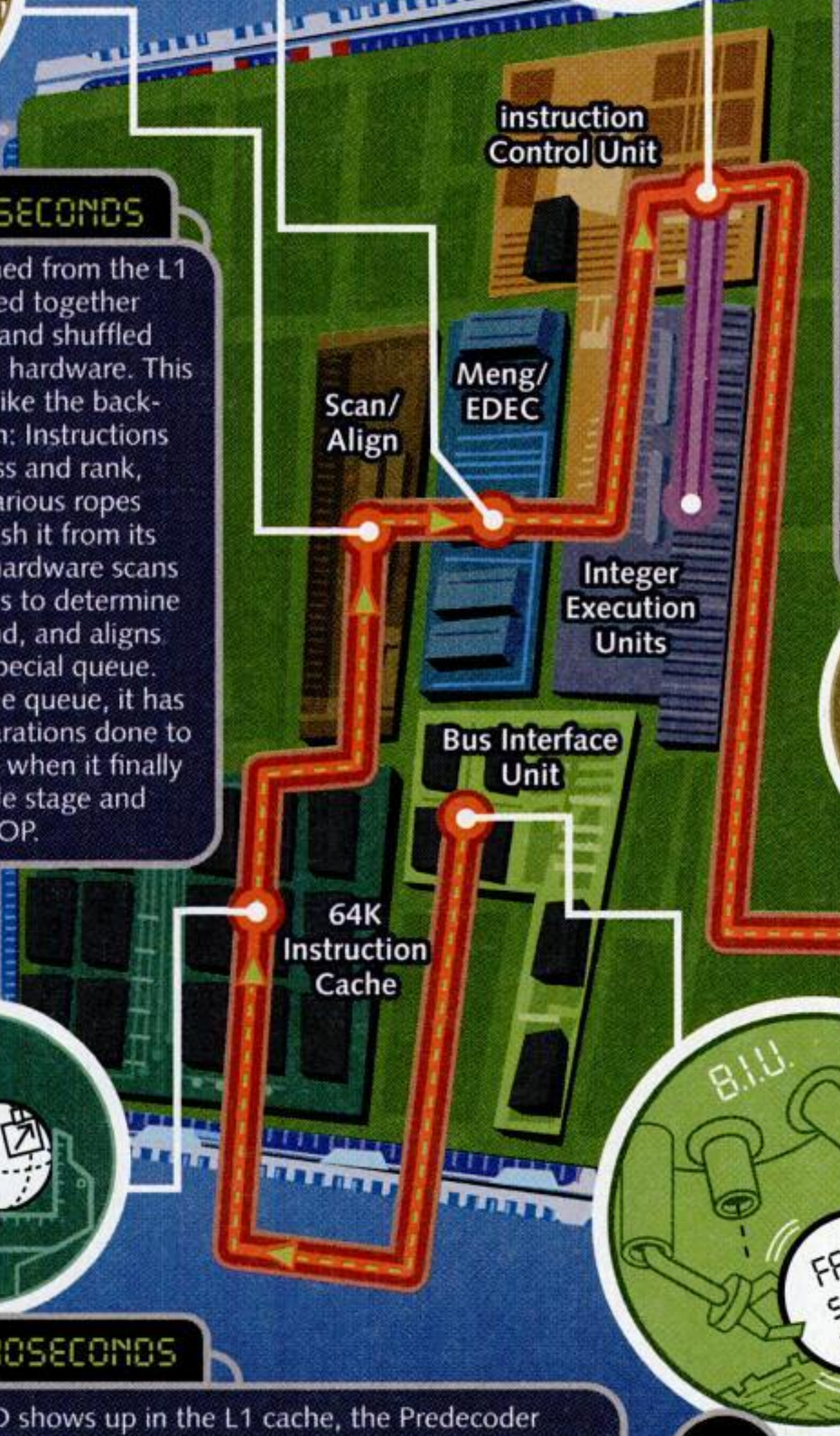
5 16 NANOSECONDS

In the 36-entry Floating-Point Scheduler, our MacroOP FADD is decoded into an OP. But even after the Scheduler finishes this final decoding, its job still isn't over. It still needs to decide when and how the OP should be executed. The Scheduler does this by surveying the other OPs under its care and assessing which execution resources (in the form of registers and execution units) are currently available and which are about to free up. When the Scheduler is able to allocate sufficient resources to the OP, it sends the FADD to the Floating-Point Execution Unit (FPU) to be processed.



3 11 NANOSECONDS

Next, our FADD is fetched from the L1 instruction cache, lumped together with a few of its peers, and shuffled along to the Scan/Align hardware. This hardware is somewhat like the back-stage area at graduation: Instructions line up according to class and rank, and each puts on the various ropes and stoles that distinguish it from its peers. The Scan/Align hardware scans the group of instructions to determine where they start and end, and aligns them accordingly in a special queue. While our FADD is in the queue, it has a few last-minute preparations done to it so it'll be ready to roll when it finally reaches the early-decode stage and graduates into a MacroOP.



7 22 NANOSECONDS

Our FADD, having been fully decoded and prepared for execution, now arrives on schedule for final processing at the Floating-Point Execution Unit. All of the above mojo was just preparation for what goes on right here: the actual business of adding the two floating-point numbers. The FPU takes the two numbers from the st(0) and st(1) registers, adds them, and stores the sum in the destination register, st(0). Our FADD has now completed its trip through the Athlon's pipeline, and its result is available for use in the next computation.

17 NANOSECONDS

6

2 10 NANOSECONDS

As soon as our FADD shows up in the L1 cache, the Predecoder goes to work on it, tacking extra info onto the instruction in order to prepare it for the early decode phase. The Predecoder's added information marks off the boundaries between the variable-length x86 instructions, and lets the early-decode hardware know whether our FADD is a DirectPath or VectorPath instruction. Since our FADD is a DirectPath instruction, when it hits the early-decode stage, it will be decoded directly in hardware, as opposed to passing through the Athlon's microcode engine as a VectorPath instruction would.

START

1 0 NANOSECONDS

Before the Athlon can put our instruction into the pipeline, it must fetch it from main memory, where the most recently used portions of the program's code are temporarily stored. The Athlon's Bus Interface Unit (BIU) does the actual work of fetching the FADD and loading it into the L1 instruction cache, which is the first stop for all instructions on their way into the CPU. The BIU is the Athlon's liaison with the rest of the memory system; when the Athlon needs a piece of code or data, the BIU is there with the hook-up.

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The Road Beyond 1GHz: What's Next?

This year, advances from both AMD and Intel will grab the performance curve, ball it up, and toss it in the garbage.

First, the news out of Santa Clara:

▶ **Performance Desktops** We'd be surprised if you could find a 1GHz Pentium III right now. These 1GHz CPUs will be offered in extremely limited quantities until Q3 2000, and it's debatable whether Intel will continue pushing speeds with the P-III if the Athlon really takes hold. The real battle will begin in the second half of the year when Intel unleashes its new IA-32 Willamette core (see page 20). Already running at 1.5GHz (or 1,500MHz), the "Pentium IV" is clearly expected to be Intel's savior from the mongrel Athlon hoards.

▶ **Budget Systems** Running at 566MHz and 600MHz, Celeron will get a boost in performance by adopting the Coppermine core, but with only 128KB of L2 cache. Surprisingly, Intel will keep Celeron confined to the 66MHz bus ghetto for now, but that strategy may change if competition gets tougher.

Also on-deck is Intel's Timna, which integrates a CPU, memory controller, and graphics card into a single chip. Timna is expected to debut at less than 600MHz.

▶ **Servers** Itanium (alias "IA-64," alias "Merced") is still on target for an 800MHz launch this year, with full-speed, off-die L3 at 2MB and 4MB (Intel hasn't yet specified L2 amount or location). Itanium, with its terabytes of memory address space, is intended for corporate folk who need large arrays of data. For those with less intense needs, Intel will likely introduce Foster, Willamette's fraternal brother that carries larger cache amounts. This year, Intel should also bump the L2 sizes of Coppermine-based Xeons up to 1MB and 2MB.

▶ **Chipsets** With its 815 Solano chipset due this quarter, Intel will finally embrace PC133 for cheapo desktops. We hypothesize that an enhancement to Solano later this year could bring ATA/100 and DDR support to the table. With the 820E, Intel should bolster Camino with support for one or two additional RIMM sockets and ATA/100. Rambus is out and DDR is in for the 870 Colusa chipset intended for Foster/Willamette server boxes. Rambus will be in, however, for the Tehama chipset, which will service the first Willamettes when they arrive in the third quarter. VIA will continue to hammer at Intel's chipsets, and plans to introduce a chipset supporting DDR later this year.

And what about the announcements coming out of Sunnyvale? This year, AMD will continue to smack Intel about the ears:

▶ **Performance Desktops** The Athlon featured in this issue is indeed historical, but it's more a proof-of-concept than AMD's magnum opus. Within months, AMD should be pushing speeds further in the Thunderbird Athlon, which features full-speed, on-die L2 cache and copper interconnects. L2 amounts aren't yet known.

▶ **Budget Systems** When it's released this summer, a budget version of the Thunderbird, code-named Spitfire, will dogfight with Intel's Celeron. With less L2 cache than the T-bird and marriage to a new Socket A connector, Spitfire could clear the sky of Celerons—so AMD hopes.

▶ **Server** Combine copper interconnects, a 0.18 process, and L2 cache sizes of up to 8MB, and you've got Mustang. Paired with four- and eight-way chipsets from API and HotRail, it will make a serious run at the server market.

▶ **Chipsets** When the AMD 750 chipset launched to support the first Athlons, it lacked 4x AGP and demanded a pricey production process. VIA's KX133 addresses many of the 750's shortcomings, and VIA plans to release chipsets later this year that support DDR SDRAM and Socket A. But AMD hasn't given up, and will release 760 and 770 chipsets late in the year that will support DDR SDRAM, ATA/100, and AGP 4x. The 770 will support two procs and a 266MHz bus; the 760 will support Socket A at 200MHz and 266MHz bus speeds. ✹

—Gordon Mah Ung

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Pick an OS, any OS

How to install four operating systems onto one PC

BY **SEAN DOWNEY**

You may think you have a full house with Windows 98, but when it comes to operating systems, you don't have to stick with the hand you've been dealt—there's plenty of room on your hard drive for other OSes. Sure, Win98 supports more hardware and software than any other operating system, but it isn't the end-all, be-all OS. More powerful alternatives—Win2000, Linux, and BeOS—provide a whole new way of working with your PC.

We'll show you how to install Windows 2000, Linux, and BeOS on a hard drive with Windows 98 to set up a quad-boot system. Each time you power up your PC, you can choose which operating system you want to run. That's right, bub: With a quad-boot setup you can realize the full potential of your PC by running three fast, multithreaded, modern OSes alongside the cobbled-together version of Windows that's currently hogging your hard drive.

Think of our quad-boot as operating system training wheels. While you're learning to navigate Linux or BeOS, you can always boot back to the more familiar terrain of Win98. Quad booting will even let you give Win2000 a whirl without disturbing your delicate hodge-podge of ill-gotten Windows apps and outdated hardware.

There is a steep price to pay for all of this flexibility. Running four different operating systems means partitioning your hard drive into four different sections, installing and maintaining four different sets of applications, troubleshooting hardware conflicts in four different environments, and searching for that damn file you downloaded the other day in four different places. It also creates a delicate house of cards on your hard drive, with multiple partitions running different file formats and no single OS capable of reading every partition. If you're seriously attached to your current Windows installation, make a complete backup before installing any new OS, because when OS installations go bad, things get really ugly.

Of course, you can keep things from getting ugly by planning out your multiple OS strategy ahead of time. For instance, you should always use FAT or FAT32 to format your primary boot partition, since all the major OSes can read these Microsoft file systems. Keep in mind that both the Win2000 and Win98 installers trample over any boot loader you have installed on the master boot record (MBR). Since the MBR is what the BIOS uses to find bootable OSes, you won't be able to boot to another operating system after installing (or re-installing) either flavor of Windows.

Also, don't put Windows 98 anywhere but the first partition of your hard drive, since it isn't as flexible as the other operating systems. All the other OSes are comfortable in whatever partition they find themselves in, as long as you install a boot loader that points your BIOS in the right direction. If you already have Windows 98 installed (which this how-to assumes), you have these first two requirements licked.

Although it may seem that Microsoft makes the only ornery OSes, both BeOS and Linux have their little installation gotchas, which we'll warn you about in the following steps. Just be sure to read this entire how-to before loading up a new OS or repartitioning your hard drive, since one wrong step means nuking the wrong partition and rendering your PC unbootable.

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For definitions of Terminator words, check out the Terminator online at www.maximumpcmag.com
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Ante Up

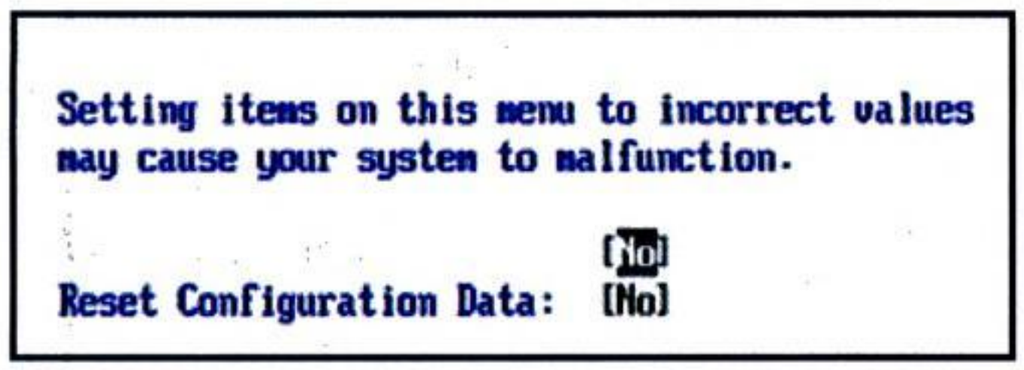
For this how-to, you'll need a copy of Windows 2000 Professional, any Linux distribution based on the latest kernel (we used Red Hat Linux 6.1), a copy of BeOS 4.5, a PC with Windows 98 pre-installed, and plenty of time to kill. You can order any of the OSes online at the Microsoft, Red Hat, or Be, Inc. web sites, and find both Win2000 and Red Hat at your local computer store.

Although we focus on quad-booting, you can use these techniques to create your own dual- or triple-boot, using any combination of the OSes named above. We didn't use it, but *System Commander* (see sidebar) offers a painless way to set up multiple OSes on your PC.

1 Prepare for Guests

Installing any alternate OS is a serious gamble. Depending on your hardware, you may find that your videocard, soundcard, or even motherboard chipset aren't fully supported by anything but Windows 98. At best, poor hardware support will cause a few glitches. At worst, it will bring your PC to its knees. Before you even pick up a copy of Windows 2000 Professional, BeOS 4.5, or any Linux distribution, be sure your hardware is supported. To check out your hardware compatibility online, go to **www.microsoft.com/windows2000/upgrade/compat/search/** for Win2000, **www.be.com/products/beosreadylist** for BeOS, and **www.redhat.com/support/hardware/** for Red Hat Linux.

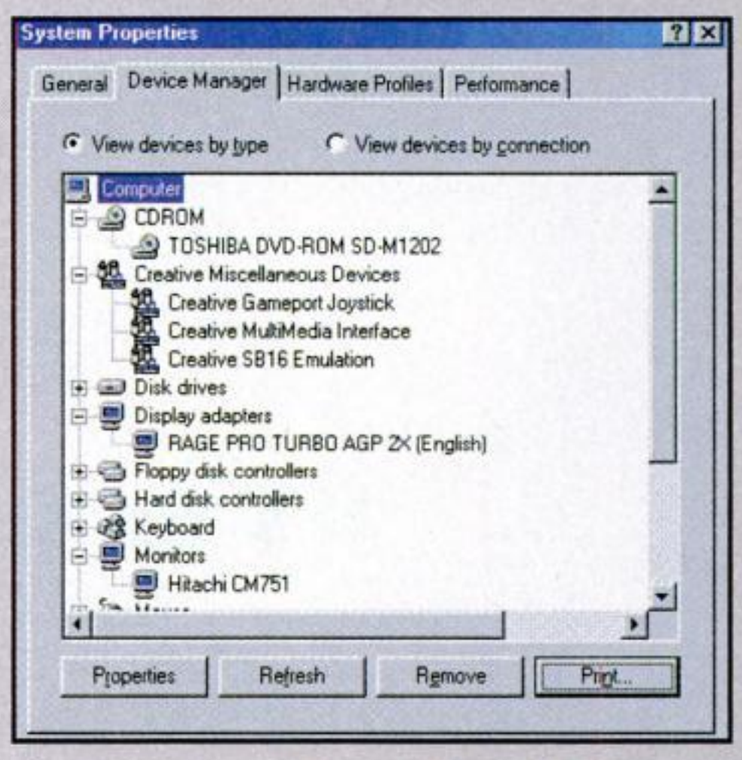
On the home front, prepare your PC for company by disabling Windows Plug-and-Play, since it will screw up the other OSes when Win98 dynamically re-assigns system resources. You can do this by entering your BIOS (normally done by hitting the F2 or DEL key during bootup), navigating to the PNP/PCI configuration screen, and switching the "Plug and Play OS" setting to "no."



By leaving the control of your hardware resources in the capable hands of your BIOS, you'll keep Win98 and Win2000 from changing such hardware settings as IRQs or memory addresses.

2 Take Inventory

You may think you're pretty intimate with your hardware, but you'll need to get even closer before installing Linux or BeOS. Since neither OS has the kind of extensive hardware detection capabilities that Win98 or Win2000 have, you could be confronted with a few unknowns during the installation process. In anticipation of installation glitches, obsessively record all the little details of your hardware. This means writing down the make and model of your motherboard, CD-ROM, soundcard, and NIC, and other such nitty-gritties as how much RAM you have and what type of mouse you use. Key to installing Linux (since just about every Linux distribution comes with X Windows nowadays) is knowing all the pertinent facts about your videocard (including how much video memory it has) and the make and model of your monitor (including the maximum screen resolution and refresh). If the X Windows configuration utility can't properly identify your video hardware, you'll need to configure it yourself.



A quick way to get all your hardware info on paper is to use Windows 98's Device Manager to print a system summary of every device installed in your system and the resources assigned to each one.

Next, determine the order in which you'll be loading your OSes. Due to a limitation with Red Hat's Disk Druid partitioning utility, we found it impossible to install Linux if Win2000 was already installed. Other Linux distributions use different partitioning utilities, so you may not suffer from the same problem, but we were essentially forced to install Linux before Windows 2000.

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3 Prepare for Downsizing

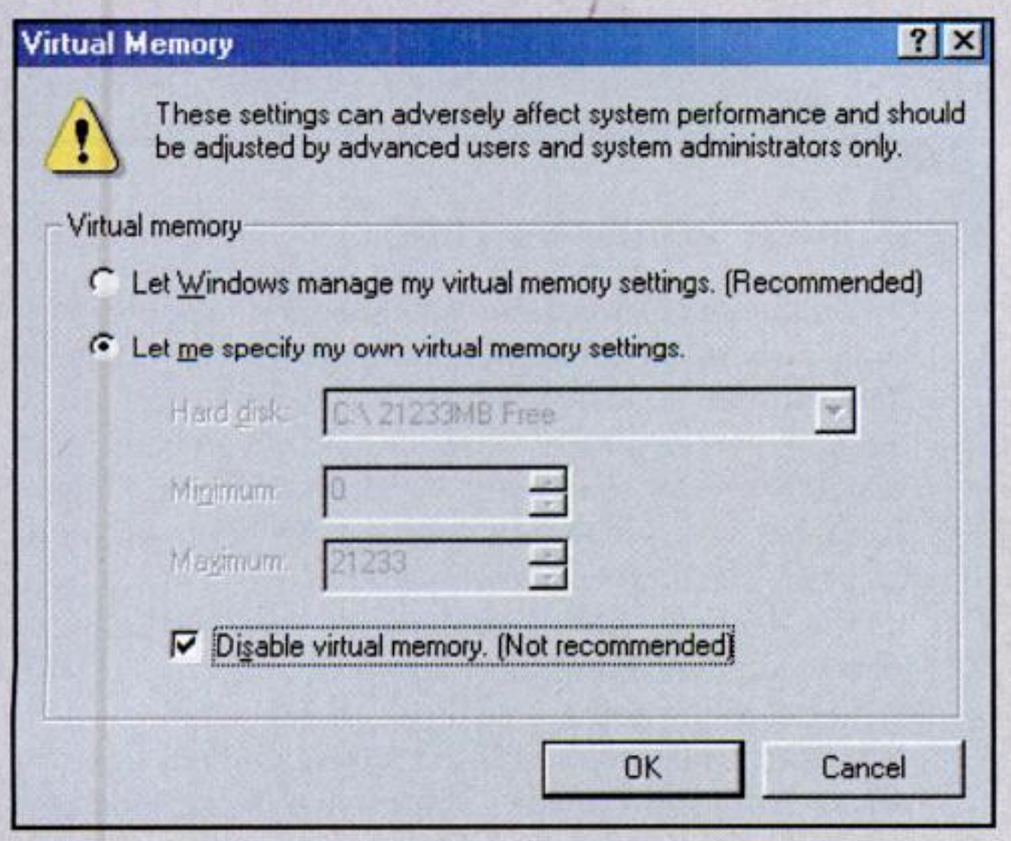
The PC we used came with one big FAT32 partition that spanned the entire 21GB hard drive. While this is the most common setup for OEM systems, your drive may be divvied into several smaller Windows volumes. In this case, it's usually best to consolidate all of your files onto a single partition before installing the three other OSes. Since each OS will be installed on its own partition, you'll save yourself a lot of grief by getting rid of the extra Windows volumes. When all of your OSes are in place, you can go back and recreate your extra Windows volumes to hold all your sundry files.

Depending on the size of your hard drive and how much you have stored on it, you may also need to clean house to free up some real estate for the other OSes. Good candidates for deletion are old games and JPG collections (you know the ones we're talking about). To install all three OSes, spare yourself at least 4GB.

We used FIPS, a Linux tool that came with Red Hat, to repartition our hard drive, since it shrinks down FAT and FAT32 partitions without wiping out the contents. If your Win98 partition is already as small as it's going to get, then you won't need to use FIPS. You will, however, need to use Fdisk to blow away any extra partitions and create enough unallocated space on your hard drive for three OSes.

FIPS isn't as sophisticated as other full-featured partitioning utilities, such as *Partition Magic,* but it's free and it gets the job done. Just don't expect it to be user-friendly. In fact, you'll need to pack all of your data down to the front of the partition to keep FIPS from wiping out any stray files. Did we mention it's a free utility? To consolidate your files, zero out your swap file by selecting "Disable Virtual Memory" from the Performance section of the Win98 System Properties. Then, Scandisk and Defrag your hard drive to move all your files to the front of the partition.

Next, create a Win98 startup floppy in the Add/Remove Control Panel. This is what you will boot from when you repartition your hard drive. The tools you need to do the partition resizing are located on the Red Hat install CD in the DOSUTILS directory. Copy RESTORRB.EXE, FIPS.EXE., and ERRORS.TXT to your Win98 startup floppy.



Unless you're using an advanced hard drive defragmenter such as Norton Utilities SpeedDisk, the Windows swap file isn't touched. By disabling the swap file, defragging your hard drive, then recreating the swap file, you optimize the entire hard drive.

4 Resize and Remove

Boot up your PC on the Win98 Startup disk that you created in step 3 and run FIPS from the DOS command prompt. If you have more than one hard drive, tell FIPS to work its magic on the first one. The program gives you the option to back up the boot sector to a floppy

```
Do you want to make a backup copy of your root and boot sector before
proceeding (y/n)? y
Do you have a bootable floppy disk in drive A: as described in the
documentation (y/n)? y

Writing file a:\rootboot.000

Enter start cylinder for new partition (67 - 2747):

Use the cursor keys to choose the cylinder, <enter> to continue

Old partition      Cylinder        New Partition
 4094.7 MB           522            17461.3 MB
```

Record the amount of space your data takes up on your hard drive before shrinking the size of the primary partition.

before making any changes. This is highly recommended.

When it comes to the actual resizing process, FIPS offers an unusual way to adjust your partition size: Scroll through cylinder numbers until you reach the place where you want to create a second primary partition. On our 21GB IDE hard drive we reduced the size of our Windows FAT32 partition to 4GB and created a 17GB DOS partition (starting the new partition at cylinder 522). You can shrink your

```
     |       |     Start      |      |      End       | Start  |Number of|
Part.|bootable|Head Cyl. Sector|System|Head Cyl. Sector| Sector |Sectors  |  MB
-----+--------+----------------+------+----------------+--------+---------+----
1    |   yes  |  1    0     1  |  0Ch | 254  521    63 |     63 | 8385867 | 4094
2    |    no  |  0  522     1  |  0Ch | 254 2747    63 | 8385930 |35766690 |17461
3    |    no  |  0    0     0  |  00h |   0    0     0 |      0 |       0 |    0
4    |    no  |  0    0     0  |  00h |   0    0     0 |      0 |       0 |    0
```

After FIPS has worked its mojo on your hard drive, you will have two primary partitions: one that contains Win98 and one that contains a whole lot of emptiness.

Win98 partition to any size you like, but keep in mind the amount of data on your hard drive. If the Win98 partition shrinks to 2GB and you have 2.5GB of data, you'll be missing something when you reboot into Windows.

Once you have a Win98 partition that doesn't hog all the space

```
                    Delete Primary DOS Partition

Current fixed disk drive: 1

Partition  Status   Type    Volume Label  Mbytes   System   Usage
 C: 1        A    PRI DOS   WINDOWS       4095   FAT32      19%
 D: 2             PRI DOS                17461   UNKNOWN    81%


Total disk space is 21556 Mbytes (1 Mbyte = 1048576 bytes)



WARNING! Data in the deleted Primary DOS Partition will be lost.
What primary partition do you want to delete..? [2]
Enter Volume Label.....................? [           ]
Are you sure (Y/N).....................? [Y]

Press Esc to return to FDISK Options
```

The second primary partition doesn't do you any good when installing three different OSes, so the best thing to do is delete the partition with FDISK.

on your hard drive, reboot from your startup disk again and run FDISK to remove any extra partitions, including the second primary partition you just created with FIPS. The main idea here is to consolidate Win98 into one place and leave the rest of your hard drive open to allow the other OS installation programs to create their own partitions. At a DOS prompt, run FDISK and display your partition information by hitting 4. The first primary partition displayed by FDISK is

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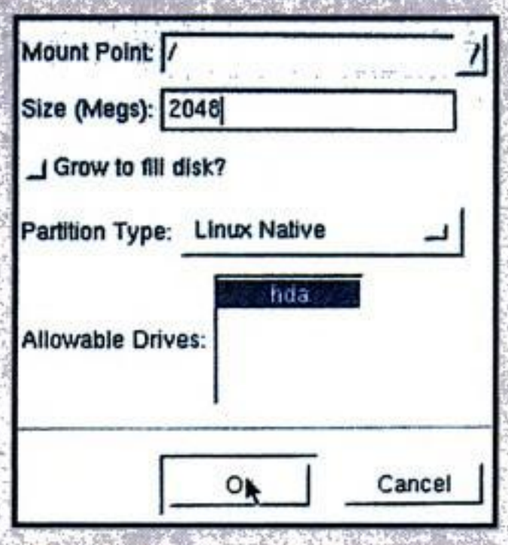
the one you want to leave intact: everything else can go. Just remember that there is no undo command with FDISK—once you delete a partition, it's gone. If you're unsure which partition needs to be deleted, exit the program and double check for any stray files on any other drive volume but your C: drive. The FDISK delete menu can be reached by hitting 3. To delete the extra primary partition you created with FIPS, select the number one from the menu, and choose the second partition. To remove an extended partition, first remove any logical partitions that it contains.

When it's done, FDISK will ask you to reboot your PC for the changes to take effect. Boot into Windows 98 to ensure it still runs and recreate your swap file in the System Properties if you haven't already done so.

5 Create Linux Partitions

The easiest way to install Linux is to boot from the Red Hat Linux install CD. If your PC doesn't support bootable CDs, use the Red Hat boot floppy. The new wizard-driven graphical installer will automatically launch and hold your hand through the entire setup process. The only important decisions you need to make are how you want your partitions set up and what installation type you want on your PC.

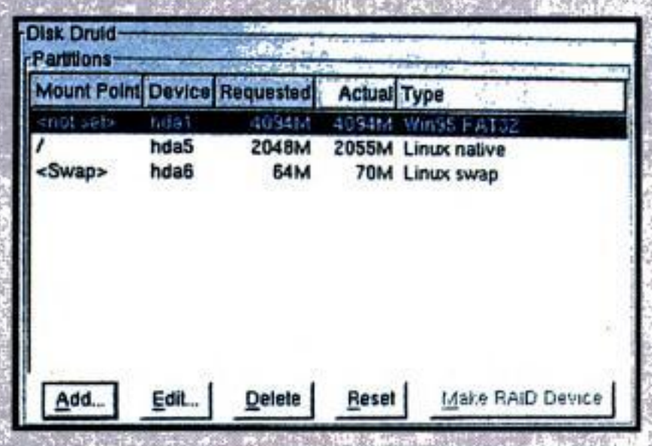
Normally, we would recommend going with the default workstation installation type, but since that automatically installs the LILO boot loader—which we don't need— We went with a custom install. LILO is a competent boot loader if you're just booting between Win98 and Linux, but in our quad-boot setup, it just gets in the way.



The slash represents "root directory," which is the mount point of the main Linux partition. Be sure the "Grow to fill disk" option is unchecked or your new partition will fill up the rest of your hard drive.

The Red Hat installer uses Disk Druid to handle the partitioning duties. For a proper Linux install, you'll need to create and designate one partition as your Linux swap space and the other as your Linux native space. If you're unsure of how you want your drive partitioned, you can always use the back button to quit Disk Druid without effecting any partition changes.

When DiskDruid loads, it presents you with a list of the partitions on your hard drive, from which you can delete or add as needed. When you create a partition with Disk Druid, you also choose its mount point. In Linux-speak, the mount point indicates where the partition will be mounted when Linux is up and running. Using Disk Druid, we created a 2GB Linux root partition and a 64MB Linux swap partition, but realistically you only need a 32MB swap and 1GB root.

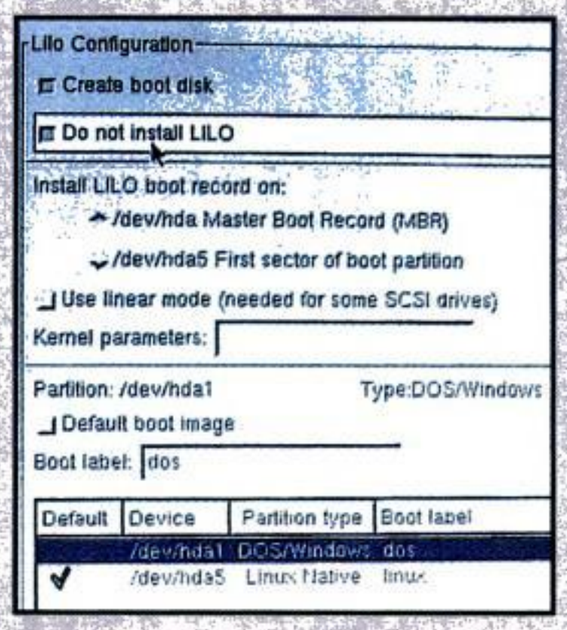


The swap partition should be at least 32MB or (ideally) match your memory, though you shouldn't need a swap partition larger than 64 MB unless you're using the most complex apps.

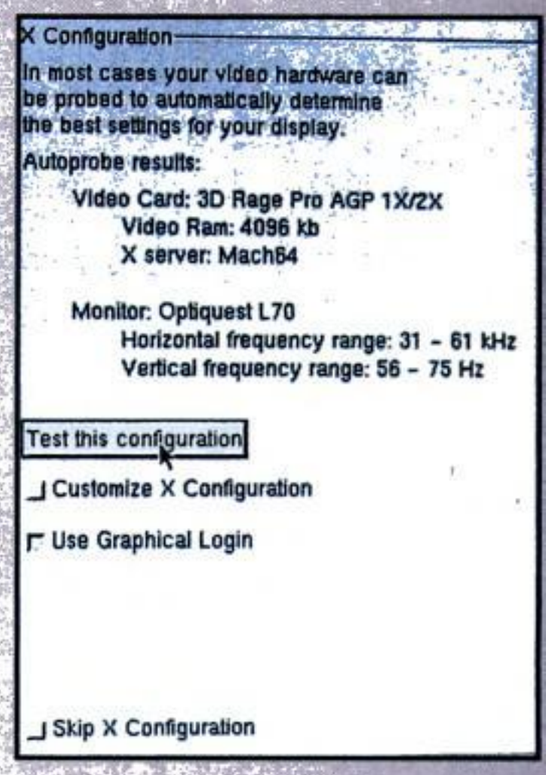
6 Install Linux

Once the Red Hat installer knows where to put all the Linux files, it will ask what components to install by presenting you with a list of individual packages. Each package represents a group of programs that add more functionality to your Linux installation, at the price of bloating the OS. We installed the default packages for now, since Red Hat allows you to easily add new packages later.

Once your packages are chosen, the installer will take you to the LILO configuration screen. Since we'll be using the BeOS Boot Manager, we chose not to install LILO on the MBR of our hard drive. Unfortunately, without LILO, you won't be able to boot into Linux without a Linux boot disk, which you should create during the installation process. If you can't wait until you install the BeOS Boot Manager to ensure the Linux installation works, boot from the floppy.



LILO isn't quite as flexible as the BeOS Boot Manager, so we chose not to install it. If you're just booting between Win98 and Linux, however, LILO is a handy boot loader.



The Red Hat installer will automatically probe your videocard and monitor to figure out how to configure X Windows. If it can't properly identify your hardware, you will need to provide the necessary details yourself.

7 Enter Windows 2000

When the Red Hat installer is finished, remove the Linux installation disks and reboot into Win98. Pop in the Windows 2000 installation CD, launch the Setup program, and choose a "Clean Install." By default, Win2000 will try to upgrade Windows 98 to Windows 2000, but since we're setting up a quad-boot, we want to install Win2000 in its own partition.

The Windows 2000 Setup program is almost completely automated, but there are some important installation options to choose. The first is found under Advanced Options in the Select Special Options box. The Advanced Options box lets you change the location of the Win2000 installation files, choose to copy everything to the hard drive before installing (to speed installation), and tell the Setup program that you want to choose where Win2000 installs.

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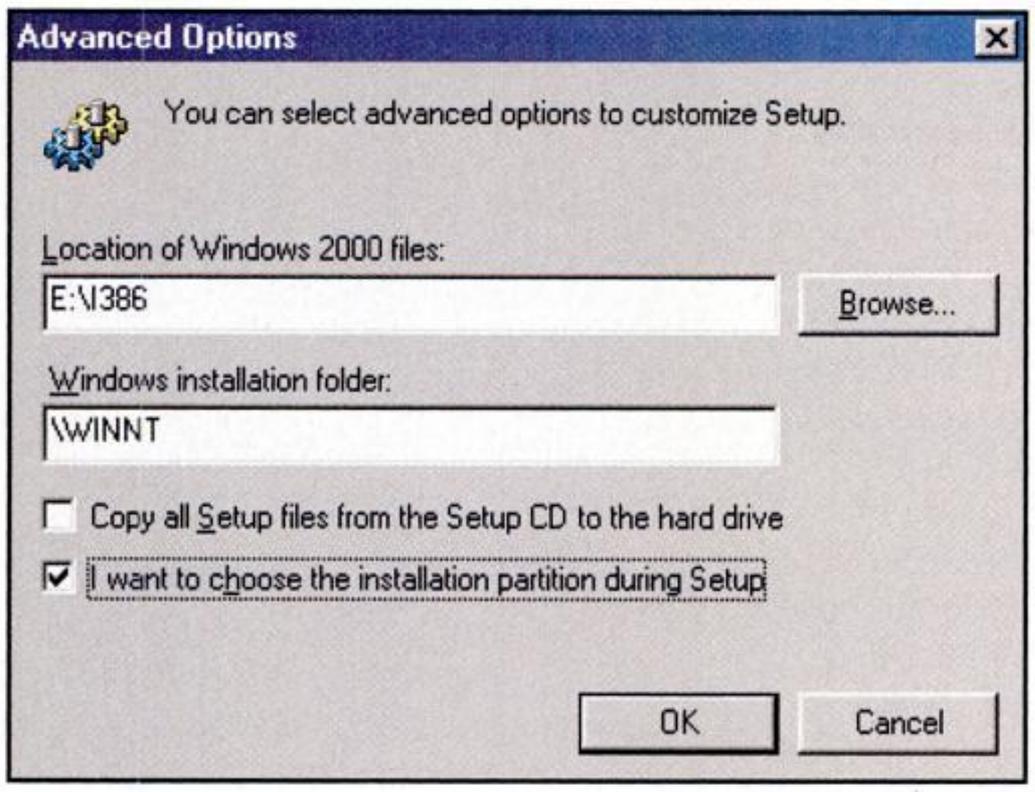
If you don't tell the Setup program that you want to choose the installation partition, it will be left to its own devices. Most likely, this means that it will plop the Win2000 files on top of your Win98 partition, which is the pits, since we want Win2000 to live in its own partition. Putting Win2000 in the same place as Win98 means the installer will upgrade Windows 98 to Windows 2000 despite your best intentions.

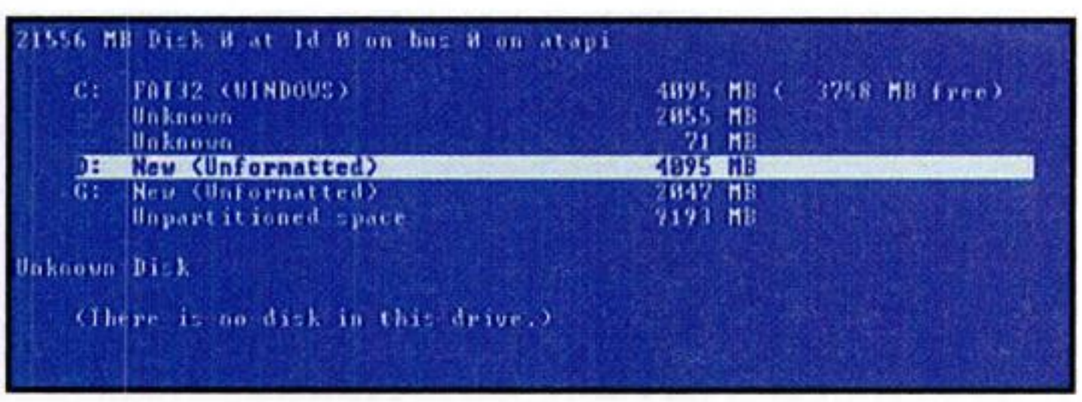
If the Win2000 installer detects an OS other than Win98, it will tell you that it can't upgrade.



Be sure to check the box next to "I want to choose the installation partition during setup," or else you'll run into problems installing Win2000 in its own partition.

8 Create a New Partition and Install Win2000

After Win2000 reboots, it will list the partitions on your hard drive and ask which to use. Select the unpartitioned space and hit 'C' to create a 4GB partition there—this is were you will install Win2000. Though you don't have to, we chose to format the partition using NTFS, since it's more efficient than FAT32. Also—

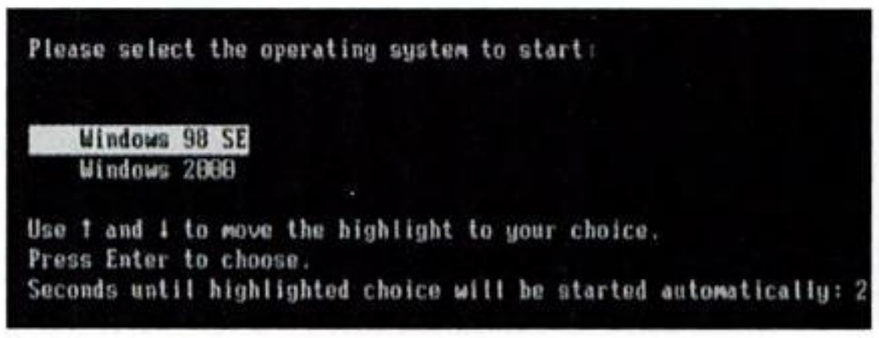


Pay particular attention to what keys you press when setting up your partitions in Win2000 because a simple key press will delete a partition.

and this is very important—as you create partitions, make an extra unformatted partition for the BeOS, since the BeOS installer can't create its own. The BeOS partition doesn't have to be big; ours is only 2GB.

When the Win2000 Setup program is done, it will reboot your PC. The first thing you'll see is the NT boot loader. When Win2000 installs, it copies your drive's boot sector to a file named BOOTSECT.DOS and replaces it with its own version, which contains the NT boot loader (NTLDR). The NT boot loader lets you specify which version of Windows you want to load. If you choose the Win98 option, the boot loader loads the original BOOTSECT.DOS, and Win98 loads. If you choose Win2000, the boot loader switches control to whatever partition Win2000 resides on.

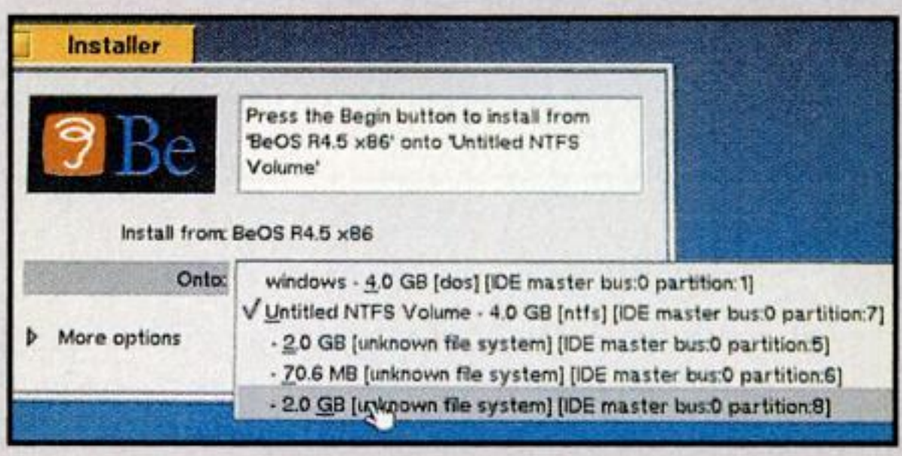
While it's handy for Win98, NT, and Win2000, the NT boot loader doesn't work well with other OSes. That's why we'll be using the BeOS's Boot Manager, which is flexible enough to work alongside the NT boot loader.



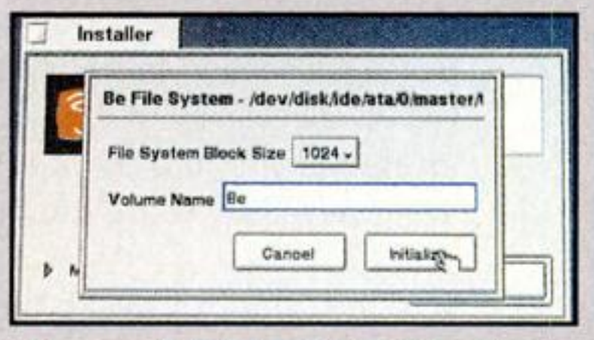
When you reboot you'll be greeted by the Win2000 boot loader, which takes you where Microsoft wants you to go today.

9 Install BeOS

After booting into Win2000 and ensuring everything is hunky-dory, insert the BeOS install floppy or CD and reboot your PC. This should automatically start the BeOS installation program—the most idiot-proof OS installer known to carbon-based life forms. The only thing you need to worry about during the installation of the BeOS is where you want to put the files.



Since the BeOS installer doesn't show the contents of your hard drive partitions, it can be a little tricky to locate the right spot for the OS. In our case the partition we wanted to use was the last one we created.



After you tell the BeOS installer where to put the OS, it will prompt you for a name and a preferred block size for the file system. We suggest going with the defaults.

When the installer asks which partition to install on, choose the unformatted 2GB partition that you created in Step 8 with the Win2000 Setup program. BeOS will initialize this partition (which in BeOS-speak means format) and ask for a block size, which you can leave at 1024k. The BeOS installer takes care of all of the little details, so just sit back and let it go.

10 Install BootMan

The BeOS BootMan config tool displays a list of all your hard drive partitions so you can tell it which ones are bootable.

When the BeOS installer is finished, it will ask to setup the BeOS Boot Manager (BootMan). Choosing yes will launch the BootMan configuration utility, which backs up your master boot record, creates a rescue disk, and scans your hard drive for formatted partitions. BootMan displays detected partitions in a menu allowing you to pick and choose which OS to include in the boot menu. Here you can customize what OS names appear in the menu, and how long to wait before launching the default OS.

On our hard drive, BootMan found Win98 FAT32, Win2000 NTFS, Linux Native, Linux Swap, and BeOS partitions. We put checks next to every bootable partition, which means no checkie for Linux Swappy. It also means that you shouldn't put a check next to the Win2000 NTFS partition, since the boot portion of Windows 2000 is actually located on the Win98 FAT32 partition. Once BootMan is installed, you can reboot your system.

Backing up your master boot record is not only the safe thing to do; it's also the best way to restore your system when you want to get rid of BeOS.

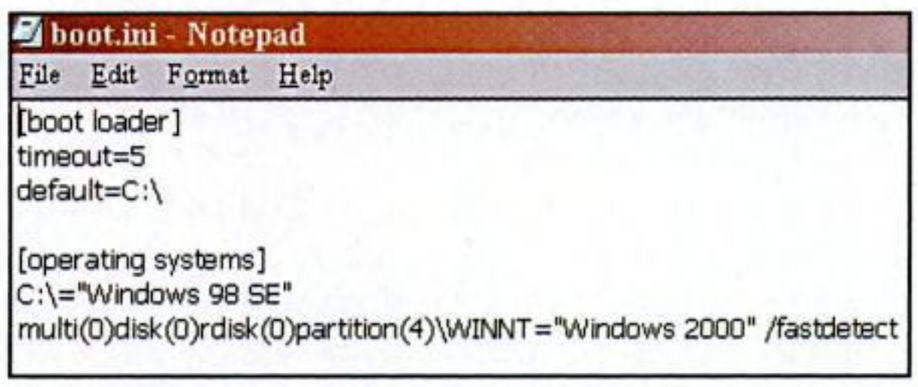
In Bootman, once you choose Windows, you'll hit a second screen to choose between 2000 and 98.

11 Customize

With both the BeOS Boot Manager and the NT boot loader in place, try booting into each operating system to make sure everything works. To boot Win98, for example, select Windows from the first menu and Windows 98 from the second. If you don't choose an OS from either menu, a default option is automatically chosen when the timer runs out. In the case of the BeOS Boot Manager the default is BeOS, and for the NT boot loader the default is Windows 2000.

Although the NT boot loader can be tweaked through the Startup and Recovery section in the Advanced Tab of the Win2000 System Properties, we've always found it easier just to edit the hidden BOOT.INI file, which is located at the root of your Win98 FAT32 partition. If you don't want Windows 2000 to be the default OS, just change the "DEFAULT=" line to Windows 98.

If you want to tweak the BeOS Boot Manager to load the default OS of your choice, open a terminal session in BeOS and type BOOTMAN to launch the BootMan wizard. After backing up your old MBR, the wizard allows you to customize your menu options and then save them to your boot record.



If you get sick of Linux or BeOS and remove the partitions from your hard drive, you'll need to change the place where the NT boot loader looks for Win2000 in the BOOT.INI.

System Commander

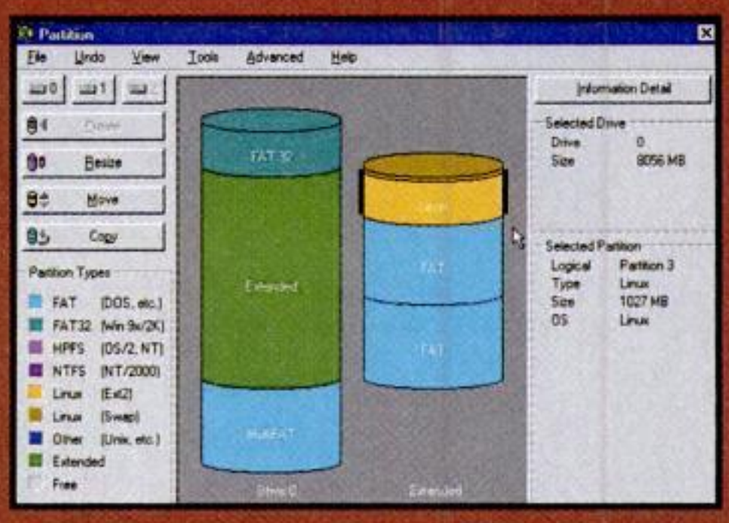
If you don't mind dropping $80, you can avoid many of the hassles of setting up and maintaining a quad-boot system by using *System Commander* 2000. It doesn't give you the same flexibility when setting up your OSes, but it makes the entire process a lot less painful.

With easy-to-use wizards that hold your hand through the process of adding a new operating system, an excellent boot manager, and powerful tools that can resize, copy, and move entire partitions, *System Commander* contains all the tools you need to install multiple OSes on your PC. It even works as a little operating system adviser, by recommending where to install your new OS and tells you how much disk space you'll need.

However, the best *System Commander 2000* feature for newbies has to be the new BackStep Wizard, which lets you undo some partition operations, and even remove unwanted OSes.

If you decide to use *System Commander,* though, you shouldn't install it after you've set up our quad-boot. Since we used two boot managers, System Commander won't be able to detect all the OSes installed.

From DOS to Linux, the *System Commander* OS Wizard knows how to set up your hard drive to make each operating system happy.



Though not as powerful as a dedicated hard drive partitioning tool, *System Commander* includes a tool that lets you resize, delete, and create the appropriate partition types for each OS.

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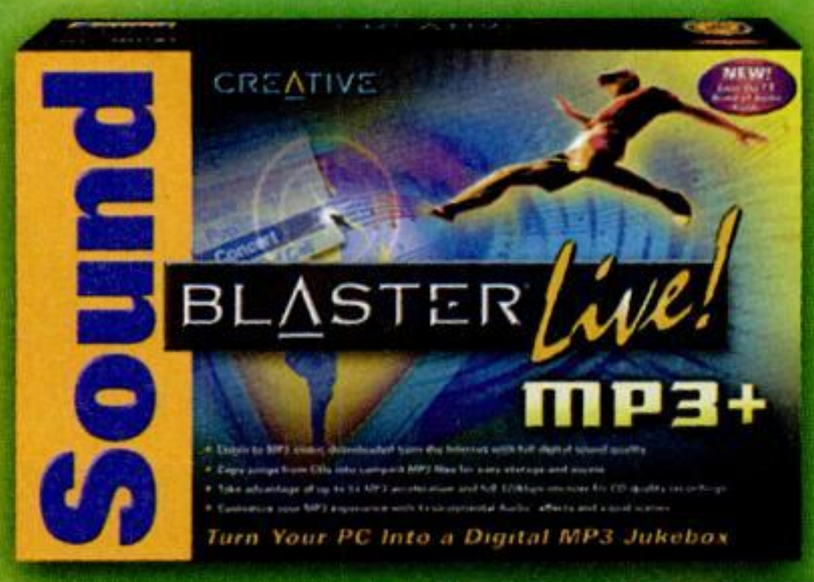

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SPE

By Geoffrey Visgilio

PHOTOGRAPHY BY JACK HUTCHESON

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speed stepping

The latest Pentium III notebooks are pumped with power and battery life

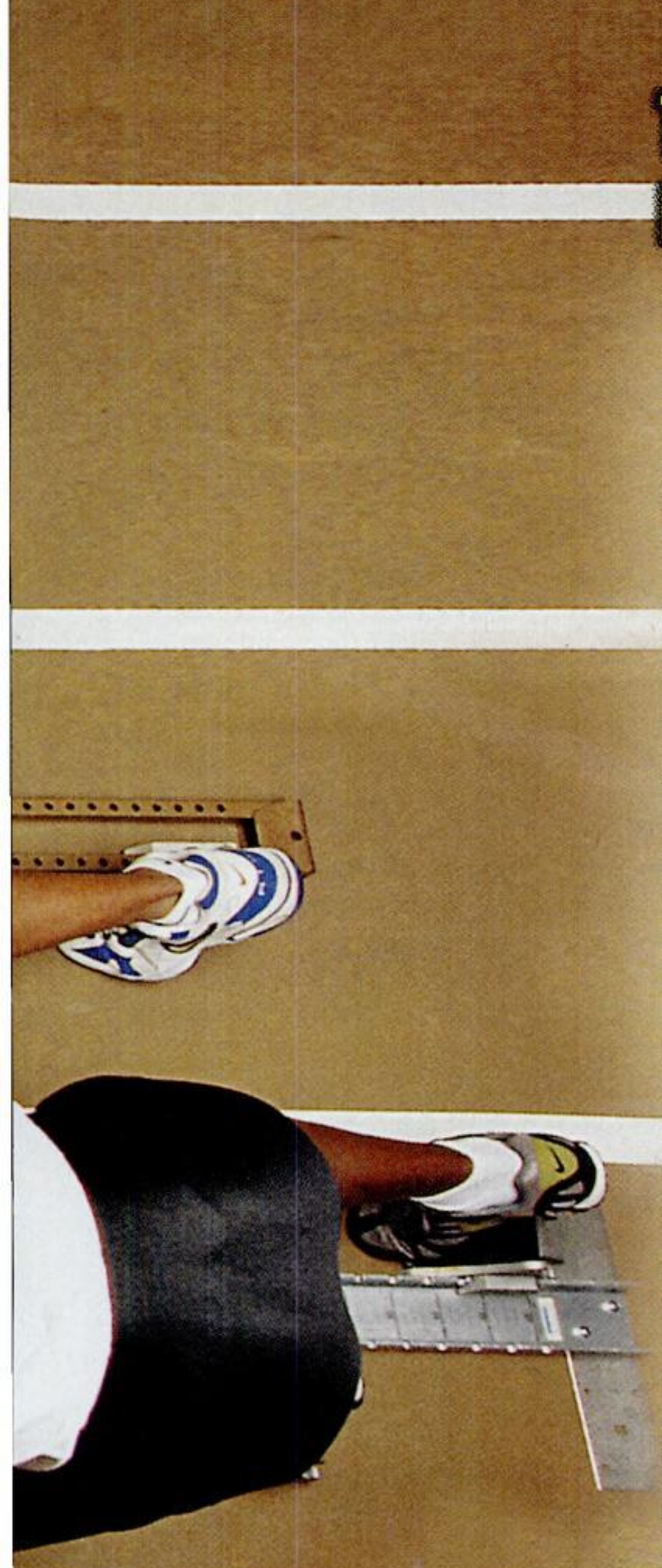
Who says slow and steady wins the race? And what good is strength without stamina? When it comes to mobile computing, we want speed and endurance—and a hot bod wouldn't be so bad, either.

We've been waiting for notebooks that are powerful enough to be useful, and equipped with enough battery power to make lugging them around worthwhile. Intel's answer is to equip its new P-III 600MHz and 650MHz mobile processors with SpeedStep technology, enabling notebooks to sprint at top speeds when running off an AC power source, but to pace themselves for extended use on battery power by automatically slowing down both the clock frequency and voltage. A compliant BIOS recognizes which power source is being used, and when battery power is employed, it automatically clocks the CPU down to 500MHz, and reduces the voltage to 1.35 volts and the wattage to 7.9 watts. The only thing the user sees is a flag icon in the system tray, and the whole process takes place in about the time it takes to yank the plug.

Don't get your Spandex in a bunch if speed is more important to you than extended battery time. You can manually toggle off SpeedStep at any time, or set the preferences so that the slow-down never takes place.

SpeedStep is striving to give notebooks more stamina, and Coppermine technology is giving them more power. The Coppie's 0.18-micron manufacturing process means cooler processors at higher clocks, and lower power requirements than the 0.25-micron technology of yore. Advanced Transfer cache—256K of full-speed, on-die L2 cache—means faster access times and fewer connectors to cause reliability problems. Add a 100MHz system bus and you've got a notebook with all the makings of a champion.

Could SpeedStepping P-III notebooks be the mobile powerhouses we've been waiting for? We put two 650MHz and two 600MHz notebooks—all SpeedStep equipped—through our benchmark decathlon. The following reviews report on how the notebooks performed while running at top speed on an AC current. On page 64, you'll find out how they ran *SYSmark2000*, our best test of real-world apps, on battery power with SpeedStep enabled.



FUJITSU E-6550 LIFEBOOK

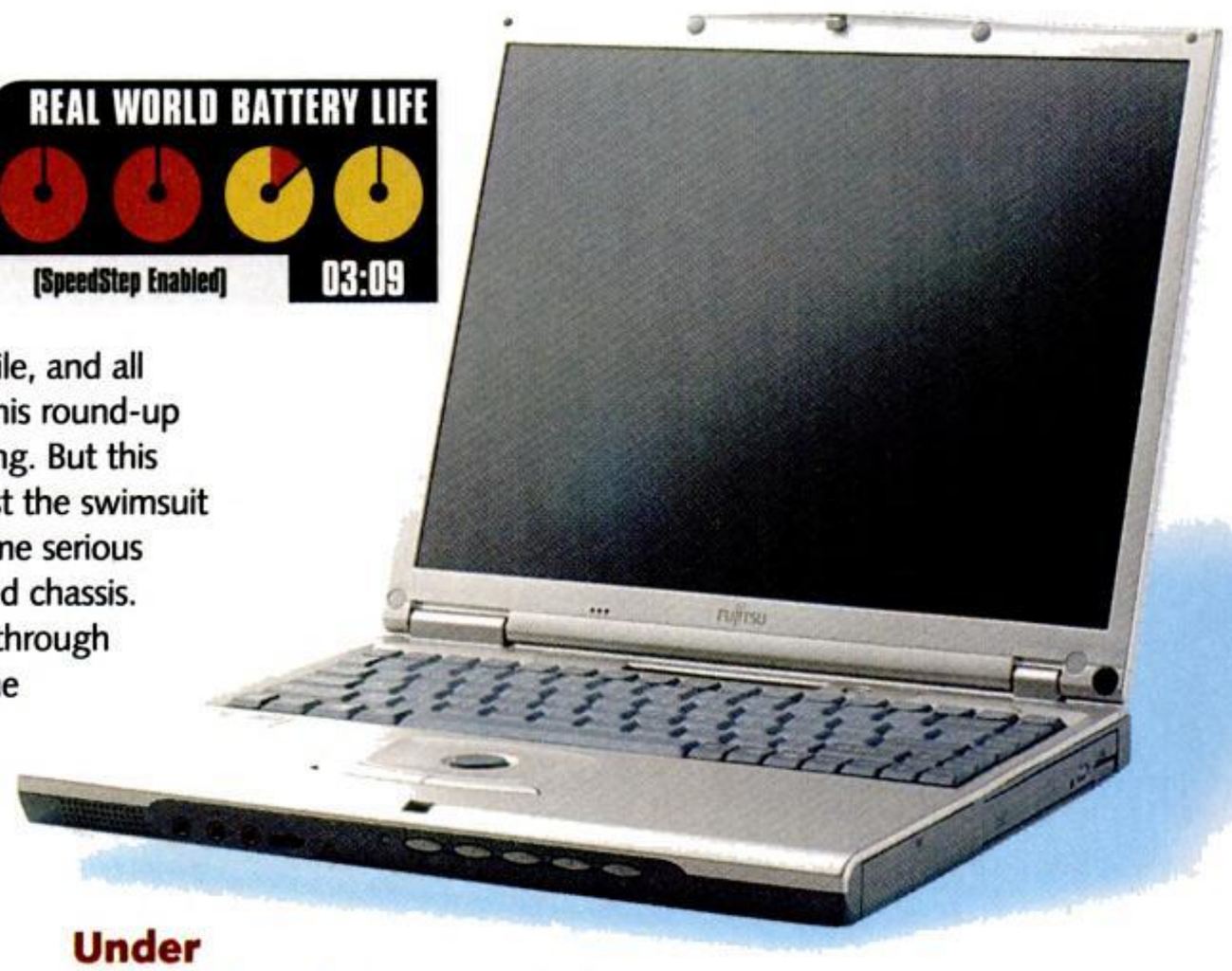
GLORIOUS SIN IN A BOX

PLUSES

- Powerful and portable
- Security panel feature is a nice touch

MINUSES

- Hell is a half-assed pointing device
- Have to swap drives to use legacy floppy



It's sleek, it's sexy, and it's got a SpeedStep 650/500 Coppermine. One look at the Lifebook's metallic case and super-slim profile, and all the other notebooks is this round-up seemed blocky and boring. But this baby wins more than just the swimsuit competition—there's some serious juice inside its streamlined chassis.

The Lifebook ripped through *SYSmark2000* and posted a score of 125—the highest of any notebook here. It chewed up *bootMark* and spit out a score of 336.8. And it blew through the *Photoshop* test in 193 seconds; our zero-point *desktop* system, a 733 Dell Coppermine, barely outpaced it with a score of 171 seconds.

Under the Lifebook's silver shell beats a hot proc.

In our *CDTach*, *HDTach*, and gaming tests, the Lifebook's scores were about even with those of the other notebooks in this roundup, though it performed better than average in our Direct3D test and lagged at 14.2fps in the *Quake III* OpenGL test. Its only really poor performance came during our MP3 ripping/encoding test; it took 660 seconds to rip our test CD. *MusicMatch* told us Panasonic hasn't provided the necessary development specs that would allow optimization of the DVD-ROM drive for *MusicMatch*'s software, and Panasonic essentially agreed that the company's large size makes it impossible to communicate with every vendor.

The Lifebook's DVD playback was above average, but its speakers made us cringe. Even at low volumes, loud instrumental percussion made them warble; at mid-to-high volumes, the distortion was unbearable. Music CDs sounded so awful that listening through a set of headphones was a relief.

We were also concerned about the amount of heat that rose off the Lifebook, even in Battery Saving mode. After an hour of resting the machine on our laps, we were checking our thighs for burns. Eventually, the high temperature made even typing a hot-hot-hot affair. The Fujitsu is smaller and thinner than any of the other notebooks we reviewed. There can't be much room inside for air circulation and heat dissipation, and it has to go somewhere—like the keypad and mouse array. Ouch.

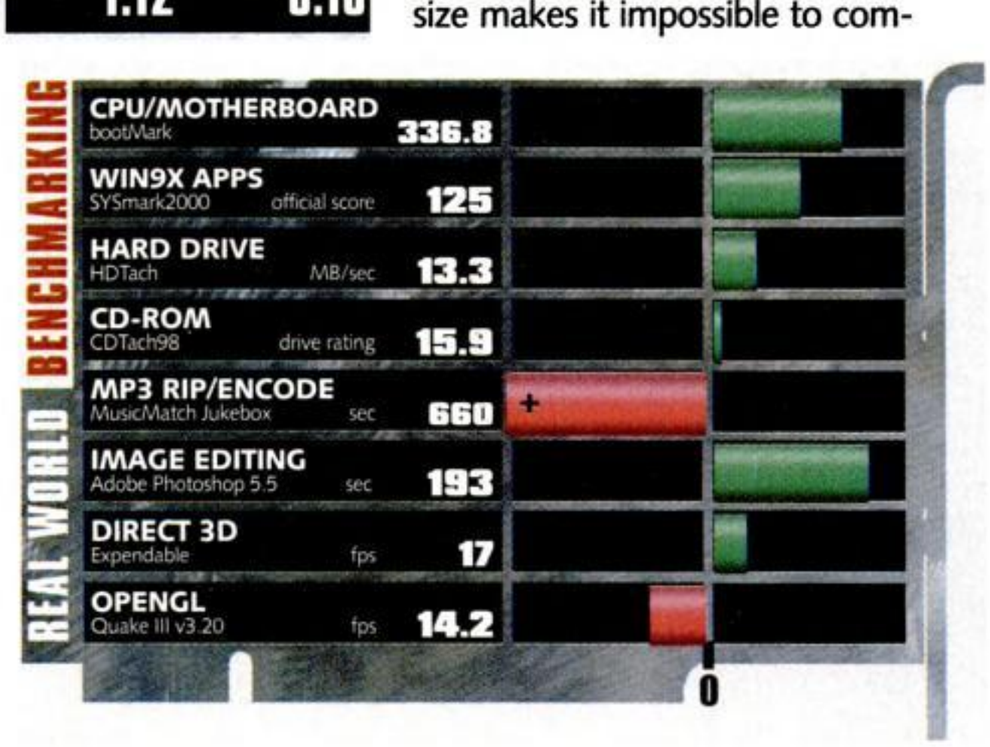
Our biggest gripe is the inclusion of a pointing stick-like device in place of a trackpad. Roller balls weren't great, but at least you could stop-and-go your way to a destination. Navigating around the screen with the mouse stick is like playing a game of Operation—your upper arms get sore trying to keep the pointer in an area long enough to click on something. Nitpicking? Maybe, but consider how integral the point-and-click is to most computing experiences. Fujitsu bundles a cordless mouse with the Lifebook, but that's only useful if there's no one sitting next to you on the plane and you can use the extra tray table.

In spite of this, when you step back and look at the whole Lifebook package, you can't help but be impressed. If Fujitsu's next notebook offering has beefier speakers, runs a little cooler, and skips the stupid mouse stick, we could very well have a Kick Ass award waiting for it.

UNDER THE HOOD

THE BRAINS	
CPU	650/500MHz Intel Mobile Pentium III
RAM	128MB SDRAM (expandable to 256MB)
I/O Ports	Dual PC card, XGA-video out, parallel, serial, USB, PS/2, floppy port, line-in, line-out, speaker out, docking station
Modem	Built-in 56.6Kbps modem
DISPLAY	
Videochip	ATI Rage Mobility-P with 4MB of SGRAM
Display	14.1-inch active-matrix
Resolution	1024x768
STORAGE	
Hard Drive	Fujitsu 12GB SMART drive
DVD-ROM	Matsushita 4x SR-8174
SOUND	
Sound	ESS-19785 + AC97 Codec
Speakers	0.5W Side-mounted stereo with SRS
TIPPING THE SCALES	
Lap Weight	6 lbs, 5 oz
Carry Weight	7 lbs

BOOT 1:12 DOWN 0:10



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SONY VAIO PCG-F480

EXQUISITE FORM, TERRIBLE FUNCTION

PLUSES

IEEE-1394 port with Adobe editing software

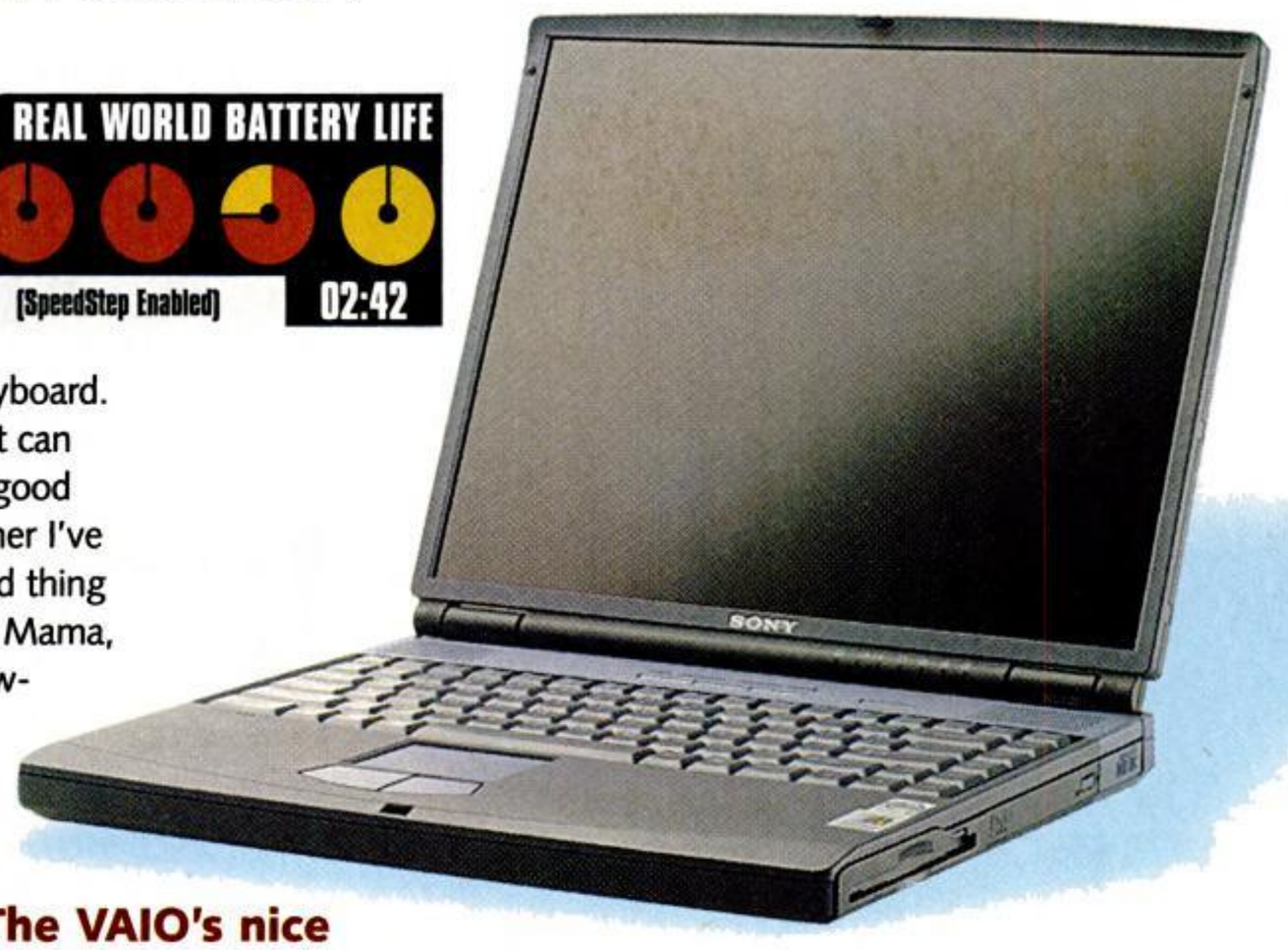
Runs cool

MINUSES

NeoMagic needs to find a tar pit to fall in

64MB of RAM is not enough

The VAIO's good looks garnered us lots of attention. Men glared at us with blind envy, furious that their own notebooks looked like bricks with a screen and a keyboard. Women gave us the look that can only mean, "That man's got good taste. I've got to tell my mother I've met The One." But it's a good thing that no one took us home to Mama, because the VAIO's hot bod conceals an underpowered, buggy notebook.



The VAIO's nice to look at, but where's the beef?

Who's the brainiac at Sony that thought it was a good idea to ship a 600/500MHz Coppermine proc with just 64MB of RAM? Attempts to do two simultaneous tasks were almost always met with "out of memory" messages. This was especially painful in light of Sony's inclusion of an IEEE-1394 FireWire port and a special edition of Adobe *Premiere*. We were so excited that video editing had reached the notebook realm, we immediately shot some video and loaded it up. But when we fired up *Premiere*, it was time to hurry up and wait; the VAIO took an hour to crunch one minute and 30 seconds of digital video, a task that takes about 15 minutes on a machine with sufficient RAM.

From there, things quickly took the turn of a Greek tragedy. After scoring an unimpressive 98 in our *SYSmark2000* benchmark—the lowest score of any system in this roundup—the VAIO hard-locked and displayed big, bright, blue screens of death when we tried to run *bootMark*. It kept pace with our zero-point Dell notebook in *CDTach* and MP3 ripping/encoding tests, which wouldn't be such a bad thing, except that the VAIO's processor is 100MHz faster than the Dell's. Supremely unimpressive.

Things went from bad to worse when we tried to run the *Quake III* and *Expendable* tests. The same Sony rocket scientist who decided on 64MB of RAM must have opted for the antiquated NeoMagic MagicMedia 256AV to handle the VAIO's graphics duties. The NeoMagic doesn't support OpenGL, so the *Quake III* test was out of the question. And the NeoMagic has just 2.5MB of video memory, so attempts to run *Expendable* yielded memory errors, or the game simply quit on startup.

With its bad video solution, we didn't expect much from the VAIO's DVD experience, and guess what? We weren't disappointed. Edges were fuzzy, bright color areas were mottled with spots, and close-ups were as grainy as any video trailer you've watched on the Internet. Consider speakers that reverbed at the slightest bass, and buggy volume control, and you'll see why we're just trying to forget the ugly VAIO DVD incident.

Though its current iteration seems packed with nastiness, we think that the VAIO has potential. Its gorgeous design makes it a real stunner on the outside, and bringing digital video to notebooks is truly a revolutionary step. In addition, the VAIO was the only notebook here that consistently ran cool; even after hours of heavy use, its keypad, trackpad, and chassis were comfortable enough to rest our tender cheeks against. Which was a good thing, because in its current iteration, the VAIO gave us one hell of a headache.

UNDER THE HOOD

THE BRAINS	
CPU	600/500MHz Intel Mobile Pentium III
RAM	64MB SDRAM (expandable to 256MB)
I/O Ports	Dual PC card, VGA, audio-in, parallel, serial, two USB, PS/2, I-link (FireWire), line-out, MIDI, floppy,
Modem	Built-in 56.6Kbps modem
DISPLAY	
Videochip	NeoMagic MagicMedia 256AV with 2.5MB of VRAM
Display	15-inch XGA TFT active-matrix
Resolution	1024x768
STORAGE	
Hard Drive	IBM 12GB DARA-212000
DVD-ROM	Toshiba 4x SD-C2202
SOUND	
Sound	Yamaha DS-XG
Speakers	0.5W rear-mounted stereo with 3D surround sound
TIPPING THE SCALES	
Lap Weight	7 lbs, 5 oz
Carry Weight	8 lbs, 3 oz

BOOT 1:06 DOWN 0:03

REAL WORLD BENCHMARKING

CPU/MOTHERBOARD bootMark		Would Not Run
WIN9X APPS SYSmark2000	official score	98
HARD DRIVE HDTach	MB/sec	11.4
CD-ROM CDTach98	drive rating	17
MP3 RIP/ENCODE MusicMatch Jukebox	sec	454
IMAGE EDITING Adobe Photoshop 5.5	sec	242
DIRECT 3D Expendable	fps	Would Not Run
OPENGL Quake III v3.20	fps	Would Not Run

0

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DELL INSPIRON 5000

THE REAL AMERICAN BEAUTY

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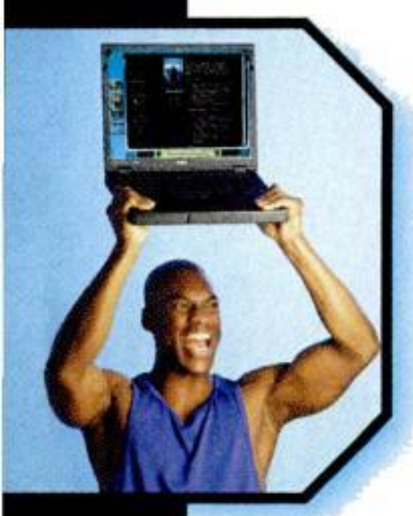
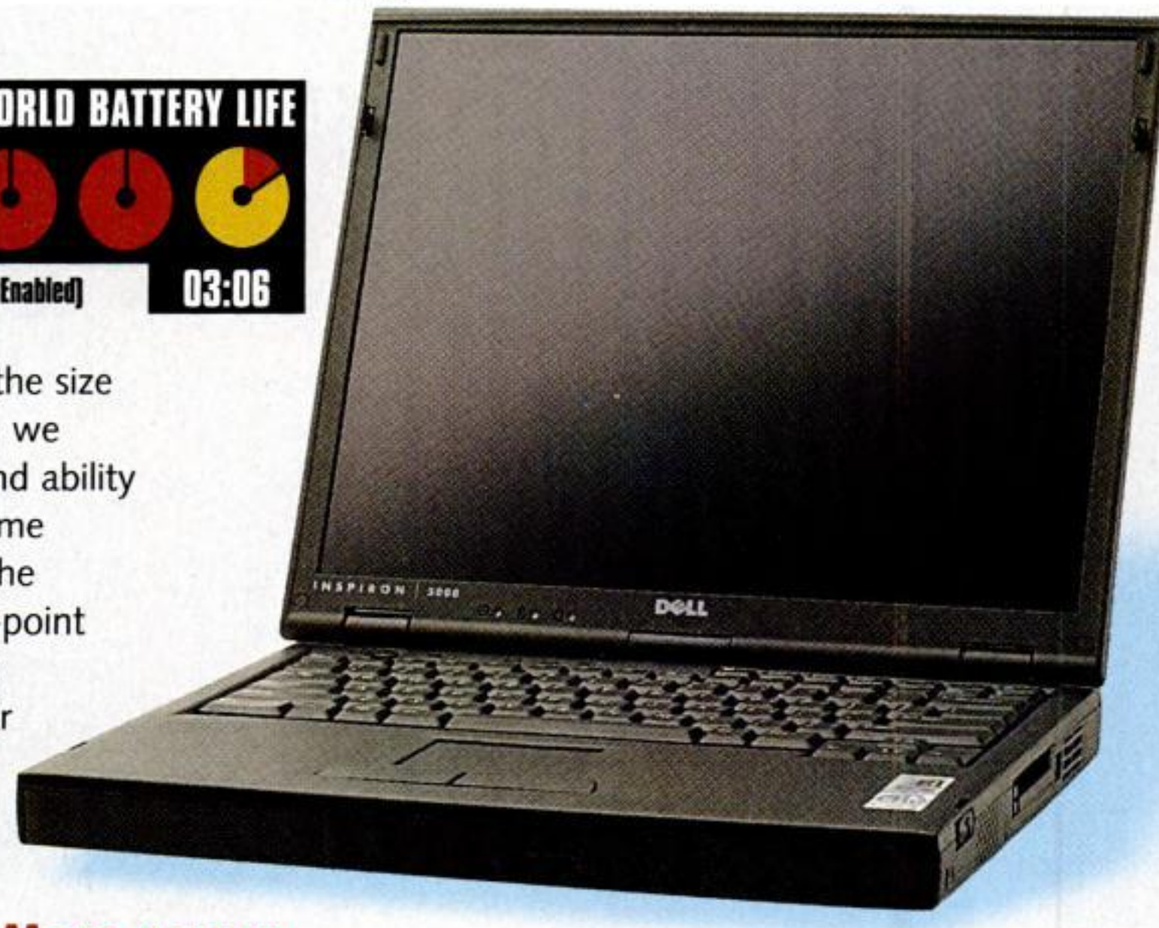


PLUSES
Unbelievable DVD playback
More power, slimmer package

MINUSES
Smaller HD and less battery life
Sooner or later, Dell's going to want it back

REAL WORLD BATTERY LIFE
[SpeedStep Enabled] 03:06



In our February issue, we chastised Dell for making the Inspiron 7500 a phenomenally powerful machine in a case the size of a small country. However, we appreciated its raw power and ability to crunch at the speed of some desktop units, so we made the Inspiron 7500 our new zero-point system. But the greedy bastard in us still wanted something pretty to look at. We wished on a star for Dell to send us the 7500's raw set of stones in a slimmer package. Our fairy godmother answered with the Inspiron 5000.

UNDER THE HOOD

THE BRAINS	
CPU	650/500MHz Intel Mobile Pentium III
RAM	128MB SDRAM (expandable to 512MB)
I/O Ports	Dual PC-card, VGA/SVGA/XGA/TV-out, Parallel (enhanced), serial (high-speed), USB, PS/2, floppy, docking station
Fax/Modem	Billionton 56Kbps PC card
DISPLAY	
Videochip	ATI Rage-Mobility P AGP with 8MB of SGRAM
Display	15-inch active-matrix
Resolution	1024x768
STORAGE	
Hard Drive	IBM 12.7GB Travelstar
DVD-ROM	Toshiba 6x SD-C2302
SOUND	
Sound	ESS Maestro 2E hardware wavetable/HRTF
Speakers	0.5 side-mounted stereo

BOOT 1:30 DOWN 0:04

With a 600/500MHz Coppermine proc, the 5000 bested its big sister in every benchmark but one: It tied the 7500 in our Direct3D test, where we expected it to pull forward a little bit. But as far as we're concerned, this is minor. The 5000 is a faster machine equipped to do almost anything the 7500 can do, but in a tighter, sleeker package.

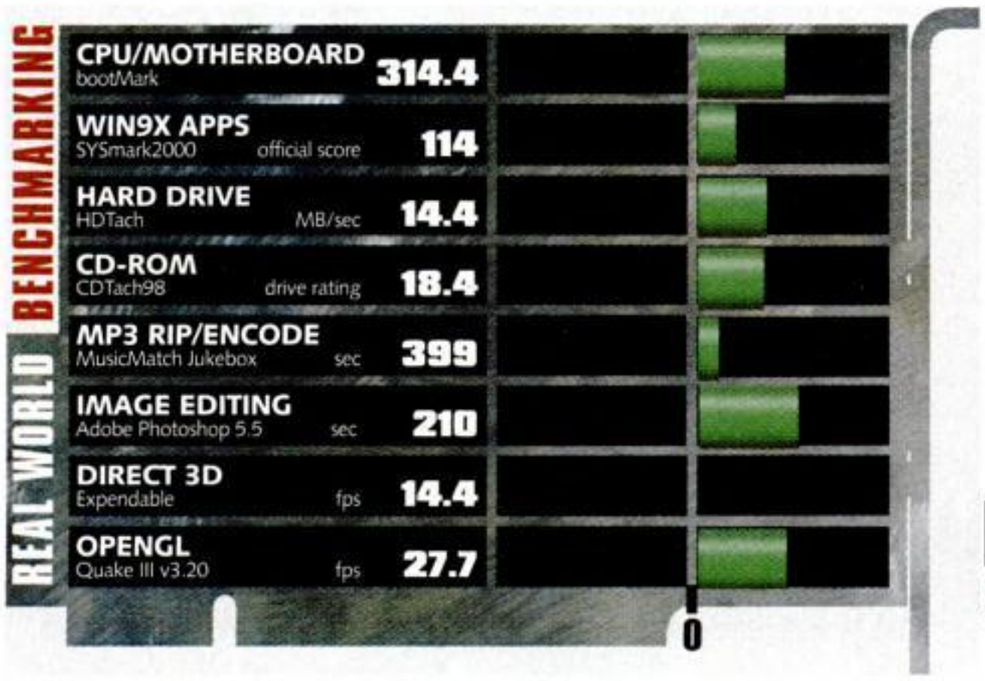
More power, less bulk—all this Dell needs is an acceptance speech.

The case redesign is marvelous. Two PC-card slots and the power port are on the right side of the case, and the floppy drive, audio controls, and modem port are on the left. The DVD-ROM drive is right up front in the center, with battery and hard drive access on either side. The Inspiron also yields a free media bay when the battery is removed and the unit is plugged in. The 15-inch display, which offers a maximum resolution of 1024x768, is of a much more manageable size than the 7500's, sitting flush with the chassis when closed instead of hanging over the edges.

Other improvements include better audio output, thanks to enhanced, side-mounted stereo speakers with simulated surround sound. They're still notebook speakers, so they can't crank out heavy bass and loud explosions the way some desktop systems can, but there was nary a tinny ring during high treble sounds, and no sign of warbly distortion during lower-end sounds. And with a set of good headphones, we actually got a near-surround-sound experience.

The 5000's DVD playback was, hands down, the best we've seen in a notebook to date. We marveled at the crisp picture quality, clarity, and accurate reproduction of color while watching *A Bug's Life*, and at the lack of distortion during rapid camera shifts in *Saving Private Ryan*. *The Matrix* had us canceling meetings and emptying the Imagine Media vending machine of microwave popcorn.

Of course, you'll sacrifice some goodies by choosing the 5000 over the 7500. Wave good-bye to the 22GB hard drive (the 5000 has a 12.7 GB hard drive), say arrivederci to two expansion bays (the 7500 has four to the 5000's two), and blow a kiss to about an hour and a half of extra battery time (over the 7500's four-plus hours). But open your arms wide to welcome a faster proc, better DVD playback, and sound output that won't make you wince. With a solid mix of form, function, portability, and power, the Dell Inspiron 5000 is the notebook we've been waiting for.



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Toshiba Tecra 8100

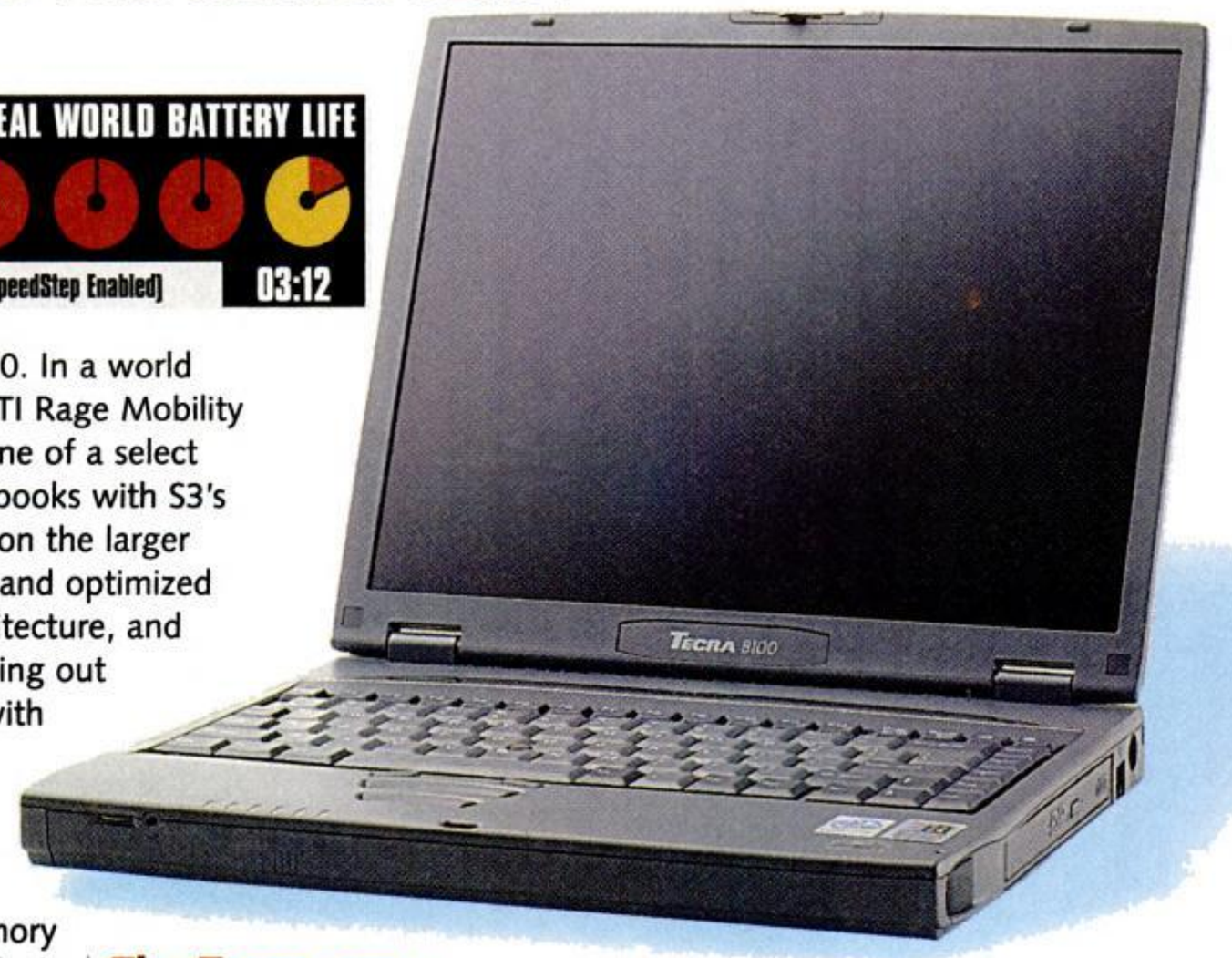
THERE'S NO SOOTHING THIS SAVAGE BEAST

PLUSES
- S3 chip
- Small and light

MINUSES
- Small screen
- Runs at about the temperature of molten lava

REAL WORLD BATTERY LIFE

(SpeedStep Enabled) 03:12



Of all the notebooks reviewed in this roundup, we were most curious about the Tecra 8100. In a world dominated by the ATI Rage Mobility chipset, Toshiba is one of a select cadre shipping notebooks with S3's new Savage MX mobile chipset. Based on the larger Savage 4 chip, the MX is shrunk down and optimized for notebooks. It features a 64-bit architecture, and a revamped 3D engine capable of pushing out 5 million triangles per second. Armed with motion compensation and dynamic front-end scaling, DVD playback on the Savage MX is on par with ATI's Rage Mobility. While the Tecra 8100 we reviewed had 8MB of onboard memory (the point at which the Rage Mobility tops out), 16MB configurations are available.

UNDER THE HOOD

THE BRAINS	
CPU	650/500MHz Intel Mobile Pentium III
RAM	128MB SDRAM (expandable to 512MB)
I/O Ports	Dual PC-card, XGA-video out, TV-out, parallel (enhanced), serial (high speed), USB, PS/2, docking station
Fax/Modem	Built-in 56Kbps PC card
DISPLAY	
Videochip	S3 Savage MX with 8MB of SGRAM
Display	14.1-inch active matrix
Resolution	1024x768
STORAGE	
Hard Drive	IBM 12GB DARA 212000
DVD-ROM	Toshiba 6x SD-C2302
SOUND	
Sound	Yamaha YMF744B-R FM audio
Speakers	0.5 side-mounted stereo

BOOT 0:50 DOWN 0:03

The Tecra came to the races with 650 ponies and a Savage MX chipset.

With all this in mind, we were pretty hot to put the Tecra through its paces. So how does it stack up? Peep this: The Tecra banged out 38.5—count 'em, *38.5fps* in our *Expendable* benchmark. In fact, no notebook we've ever seen has even come close to that score.

You want more? Try 31.2fps in *Quake III*. Yeah, it's sluggish by desktop standards, but for a notebook, it's like watching lightning. The Savage MX is fast, kiddies; we didn't expect to see the previous *Expendable* and *Quake III* records broken for at least another six months.

The Tecra's DVD playback wasn't the sumptuous feast offered by the Dell, but it was hardly a sack lunch. The Tecra's picture was darker than that of any machine we looked at, regardless of our movie choices, but it has the benefit of motion compensation for software DVD playback, which ensures smoother playback by offloading some of the MPEG-2 decoding load from the CPU.

Are we getting too gushy about the Savage? All right, we're over it—we know you're not buying a notebook to play *Quake*. You want functionality, and the ability to crunch spreadsheets as quickly as frame rates. The Tecra doesn't disappoint: It set a fat new *SYSmark2000* record with a score of 129. So go ahead, Pointdexter, and plug in all the *Excel* formulas you want.

Based on benchmarks alone, the Tecra could have grabbed a coveted Kick Ass. But it had some, as your guidance counselor/therapist might say, *issues* that we found a tad, as your guidance counselor/therapist might also say, *concerning*. Its screen is too small to do justice to DVD and graphics apps, and it employs a dreaded point-stick over a trackpad. We might have been able to deal with these—but we could not deal with the Tecra's heat. We couldn't keep the thing on our lap for more than 20 minutes without fear of spontaneous combustion, and we were sure that typing would have burned off our fingerprints. In fact, the Tecra was such an inferno, we had to wonder whether its components might start to fry during some of our more demanding tests—awesome benchmark scores aside, we didn't want to find out.

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Female Premiums

Age	10 YEAR	15 YEAR	20 YEAR	25 YEAR	30 YEAR
35	$ 295	$ 390	$ 500	$ 620	$ 720
40	$ 405	$ 530	$ 640	$ 800	$ 930
45	$ 615	$ 800	$ 900	$ 1,100	$ 1,320
50	$ 875	$ 1,115	$ 1,460	$ 1,560	$ 2,345
55	$1,305	$ 1,455	$ 2,130	$ 4,970	$ 10,060
60	$1,830	$ 2,250	$ 3,220	$16,830	$ 16,830
65	$2,875	$ 3,670	$ 7,595	$21,280	$ 21,280
70	$4,725	$ 7,775	$15,100	$28,160	$ 28,160
75	$9,955	$20,480	$27,180	$37,990	$ 58,345

Male Premiums

Age	10 YEAR	15 YEAR	20 YEAR	25 YEAR	30 YEAR
35	$ 325	$ 465	$ 600	$ 790	$ 950
40	$ 435	$ 665	$ 850	$ 1,150	$ 1,390
45	$ 735	$ 1,030	$ 1,300	$ 1,670	$ 2,010
50	$ 1,215	$ 1,695	$ 2,160	$ 2,550	$ 4,545
55	$ 1,875	$ 2,465	$ 3,060	$ 7,490	$12,520
60	$ 2,950	$ 4,285	$ 4,680	$19,620	$19,620
65	$ 5,030	$ 6,920	$12,370	$25,130	$25,130
70	$ 8,805	$13,695	$21,300	$32,850	$32,850
75	$15,755	$32,220	$32,220	$43,350	$81,725

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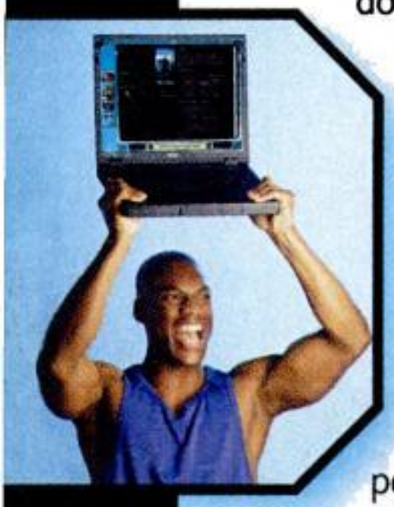
EXPOSING THE SPEEDSTEP HYPE



Will SpeedStep technology really revolutionize notebooks? At first blush, it's a winner: The proc knocks out top performance when power is plentiful, and slows down to conserve when it's not. When it's working at full tilt, the CPU can drain the battery like a hole in a bucket, but such tasks as word processing and writing e-mail are hardly CPU intensive. That should make lowering the clock speed a veritable non-issue—after all, who's doing 3D rendering during their morning bus commute? 500MHz is plenty o' power for banging out memos.

On the other hand, common sense dictates that if a task can be completed relatively quickly at a higher proc speed, it should take longer to complete at a lower proc speed. And why extend the battery life of a machine that's too sluggish to power quickly through tasks? If you're planning to spend most of your Poughkipse-to-Podunk flight crunching numbers for that big presentation, we'll take bets on what runs out first, your battery or your patience.

To test SpeedStep's proposed benefits, we charged each notebook's battery, then unplugged them all and ran *SYSmark2000* twice: once with the CPU clocked down to 500MHz per SpeedStep's command, and once with SpeedStep disabled, i.e., with the CPU running at full tilt. *SYSmark2000* is our benchmark best suited to race a notebook through real-world applications. We wanted to see the differences in performance and battery life, and to assess whether SpeedStepping notebooks' performance loss was negligible enough to make the gain in battery worth it.

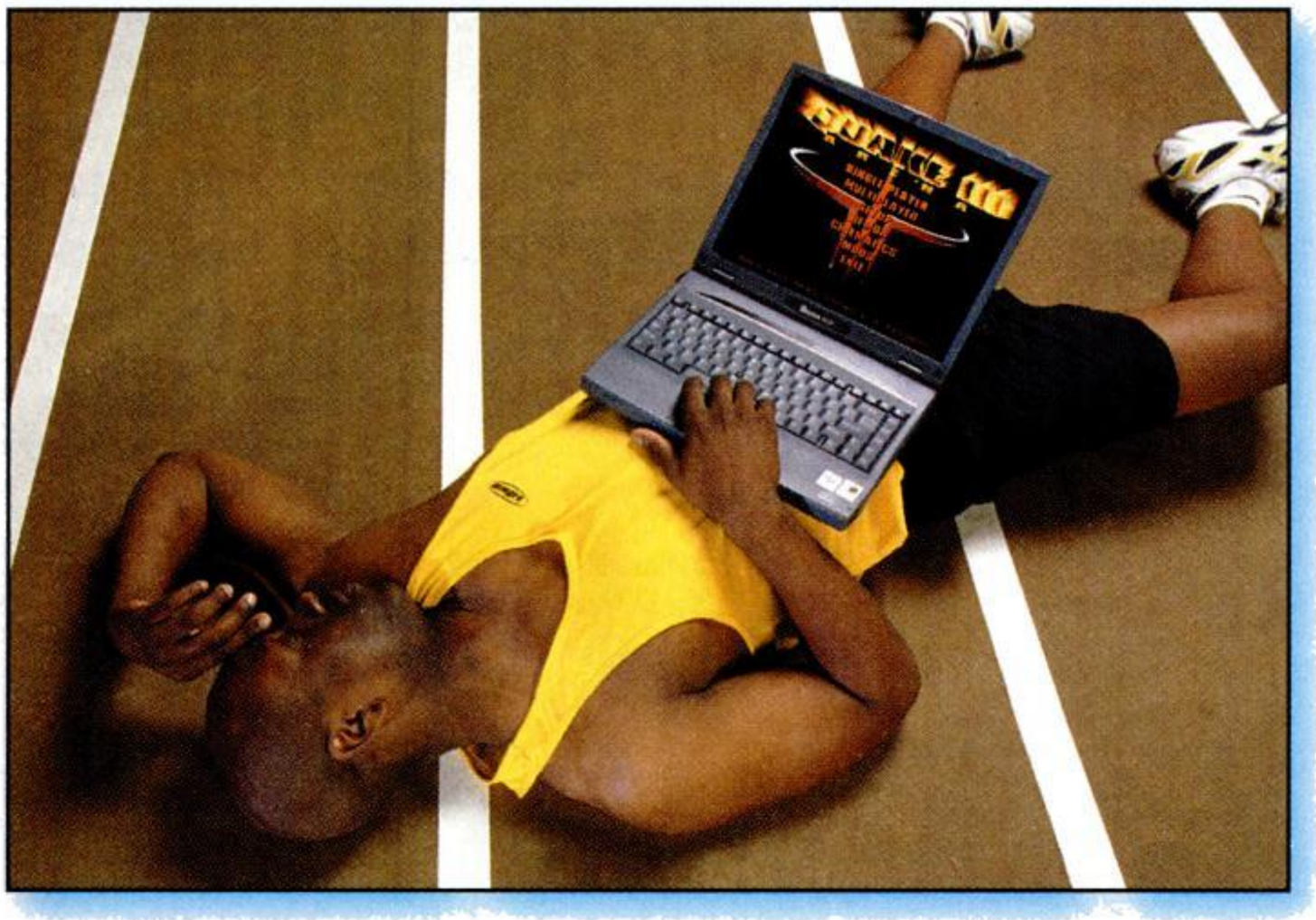
What's our take? Unless you're hoping to spend your road-trip perfecting your *Photoshop* masterpiece, it's worth letting SpeedStep throttle down your proc for lower power consumption and extra battery life. As the benchmark scores show, slowing the CPU from a sprint to a jog yields enough extra battery life to get you through the bulk of any cross-country flight, and the performance hit won't seriously affect the kind of tasks that most notebook users are doing. ✹

SPEEDSTEP DISABLED
(proc running at top speed)

	SYSmark2000 score	Battery Remaining After Test
Dell Inspiron 5000	114	29%
Sony VAIO PCG-F480	98	19%
Fujitsu E-6550 Lifebook	125	6%
Toshiba Tecra 8100	129	4%

SPEEDSTEP ENABLED
(proc running at 500MHz)

	SYSmark2000 score	Battery Remaining After Test
Dell Inspiron 5000	107	39%
Sony VAIO PCG-F480	87	27%
Fujitsu E-6550 Lifebook	109	23%
Toshiba Tecra 8100	111	20%



GOOD GAMES FOR NOTEBOOKS

First, the bad news: Forget about playing first-person shooters on your notebook. We use *Quake III* as a benchmark to test Open GL, but we'd never actually try to play it on a portable. Say goodbye to flight sims, too. And those Mech-Games? Fugheddaboutit. Too many polygons and rapid frame rates for any currently available notebook to handle. Plus, the pixel response of today's LCD screens can't keep pace with fast frame rates, and as a result, streaking occurs.

Could there be any good news, you ask? Yes: Any game running an engine that is over a year old should run quite nicely on your notebook. That means all of last year's big hits are fair game. And don't forget RPG and strategy games—you can get months of play out of them, and they'll hardly tax your system.

Our list of the best portable games for your traveling pleasure includes:

- *Diablo*
- *Baldur's Gate*
- *The Sims* (or any Sim game, such as *SimCity* or SimLife)
- *Age of Empires* (and *Tiberian Sun*)
- *Final Fantasy VII* (careful with those FMV sequences, though)
- *Tomb Raider* (1 and 2—notebooks sometimes get twitchy with the later iterations)
- *Thief: The Dark Project* (Yes, it's based on the *Quake* engine, but its frame rates are infinitesimal in comparison. And on a dark airplane with a set of headphones and positional audio, it rocks.)

Got an opinion on this article?
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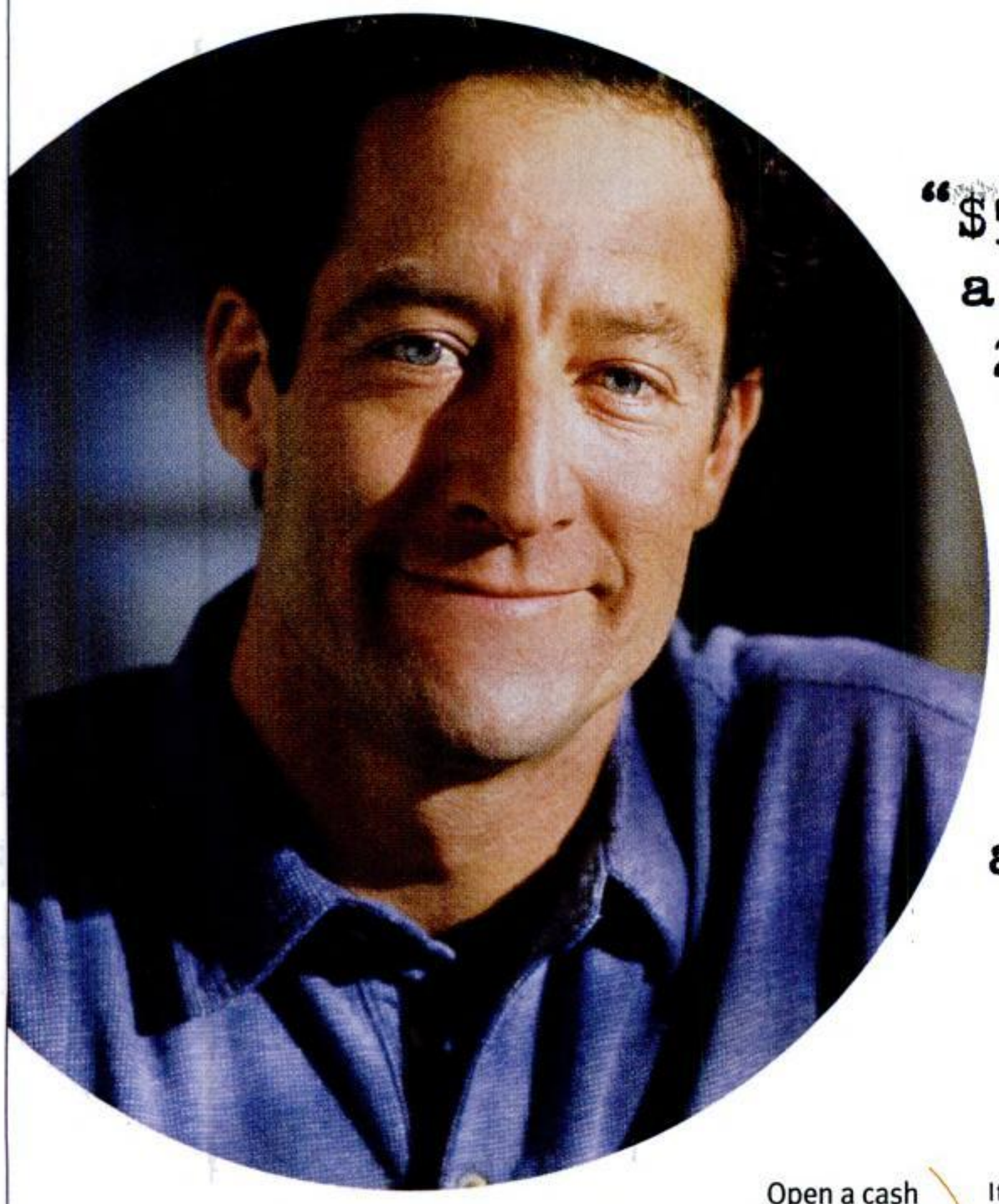

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Benchmarking Breakdown

HOW TO TEST PERFORMANCE, MAXIMUM PC-STYLE

Empirical evidence separates the boys from the men. Case in point: System X scored 50 bungholioMarks—this is bad. System Y, meanwhile, scored 100 bungholioMarks—this is good. You can argue about each system's relative merits until you're out of breath, but there's no arguing with the fact that System Y kicked System X's fatty hamhocks (at least when it comes to scoring bungholioMarks). After all, you've got the test results to prove it.

In this installation of Lab Notes, we'll tell you about our new system benchmarks and their "acceptable zero points," which we revised recently to keep pace with today's fastest technology. *Maximum PC* believes benchmarks don't mean jack unless one knows exactly what they test, so check out this report if you're interested in how we gauge performance.

Some of our benchmarks run synthetic scripts. These benchmarks can hint at overall power, but may not perfectly represent how a PC will perform with your favorite real-world software. For this very reason, most of our tests are based on real-world games and applications—a crucial approach in this age of component-savvy engineers. For example, a smart videocard engineer can tweak his drivers to run a particular synthetic benchmark very, very quickly. It's a simple matter of developing shortcuts for specific lines of code. However, it's much more difficult to cheat this way when your drivers have to chug through a full-fledged game engine.

Please note that this month we are not only revising our benchmarks, but also our zero point systems (see sidebar, page 68). This means that the green bars in our system review benchmark charts will be getting much, much shorter. Keep that in mind when you read this month's reviews.

That said, let's delve into some hardcore testing...

Gordon puts a machine through its paces in the *Maximum PC* Lab. All systems are compared against our zero-point Dell 733MHz Coppermine test system, as well as similarly configured machines from different vendors.

HITTING THE SYSMARK

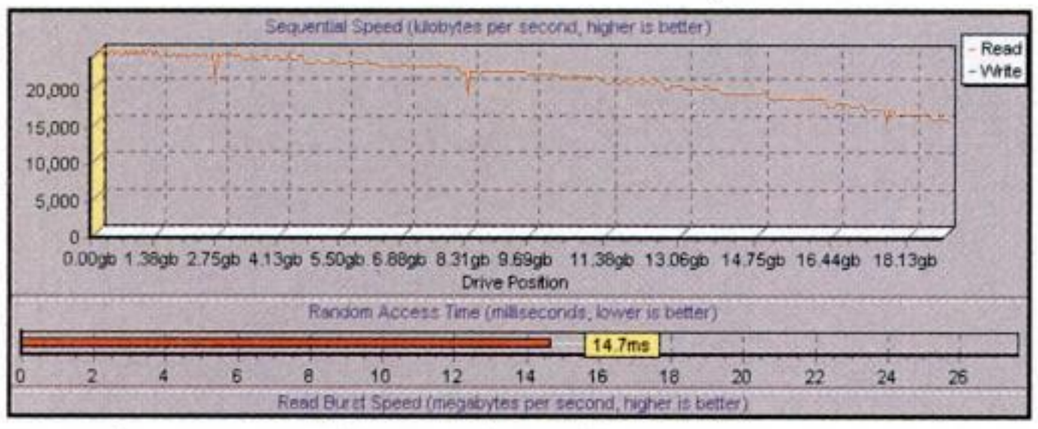
The Goliath of our real-world benchmarks is BAPCO's *SYSmark2000*. It's a script-based behemoth that tests a system's capability to execute typical actions within 12 common Windows apps. Specifically, *SYSmark2000* thrashes a system's CPU, chipset, memory, videocard, and hard drive by running the applications in a loop, and recording the amount of time it takes to execute various action scripts. The new suite differs from *SYSmark98* by reducing the total number of applications from 14 to 12, and dividing the apps into "Internet content creation" and "office productivity" instead of just plain "content creation" and "office productivity."

The Internet content creation apps include MetaCreations *Bryce 4*, Avid *Elastic Reality 3.1*, Adobe *Photoshop 5.5* and *Premiere 5.1*, and Microsoft *Windows Media Encoder 4*. The office apps include Corel *CorelDRAW 9* and *Paradox 9*, Dragon *NaturallySpeaking 4*, Netscape *Communicator 4.61*, and Microsoft *PowerPoint 2000*, *Word 2000*, and *Excel 2000*. The content creation apps tend to be more floating-point-intensive than the office apps.

After all action scripts are completed, *SYSmark2000* delivers individual scores for each application, as well as a cumulative total (higher is better) that we report in reviews. In addition to measuring a system's results against those of our zero-point system, we also compare the scores with similarly configured systems. These comparisons weigh heavily into the verdict of any systems we review.

SHAKE THAT BOOTYMARK

To test a system's CPU and chipset, we use the *bootMark*, a special version of Symantec's venerable Norton System Information benchmark. Although this benchmark was designed for Windows 95, and all of us would like Symantec to put out a new rev, we're continually impressed by its capability to scale successfully with newer, faster CPUs. When a new clock speed hits the market, the *bootMark* can ferret out the stats to expose its power. The *bootMark* works its magic by performing a series of 32-bit integer calculations that test a system's integer units, L1 and L2 cache, chipset, and memory bus. Because it



***HDTach* uses a VXD to bypass a drive's file and caching system, and reads directly from a drive's sectors. For system reviews, we report a drive's average sequential read speed, which is an average of performance across the drive's platters.**

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doesn't test floating-point power, the *bootMark* is not a great indicator of 3D gaming performance. Scores are reported according to the bootMark's internal rating scale; higher scores are better.

A-TACHING THE HARD DRIVE

After we finish systemwide tests, we benchmark individual components and sub-systems, starting with the hard drive. *HDTach* is our weapon of choice because it's extremely accurate, and provides detailed information on all of a drive's major functions. The benchmark uses a Virtual Device Driver (software that allows hardware to directly interface with the OS) to bypass all of the drive's caching and file systems, allowing the program to better determine a drive's performance.

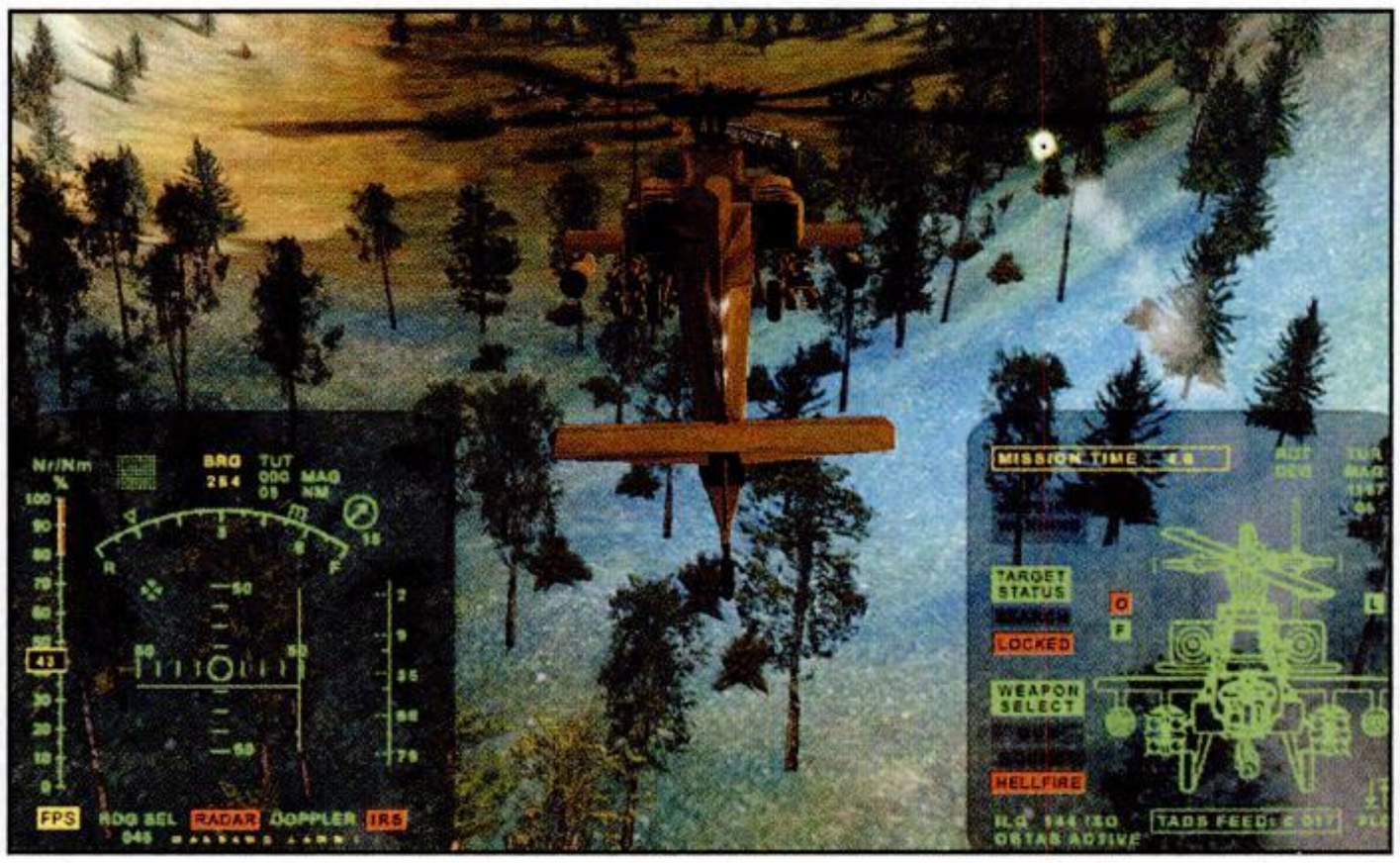
Many tests are available within *HDTach*, but for system reviews we publish only one score—drive rating. Expressed in megabytes per second (MB/sec), this is the average speed at which the read/write head moved across the platters to read data; higher scores are better.

Most hard drives write from the outside to the inside, allowing for different read/write speeds depending on where the data is located. To compensate for this, *HDTach* reads from multiple locations on the drive and spits out an average read speed, providing an overall snapshot of he drive's raw power.

AUDIO ACTION

MP3 ripping/encoding is the new kid on the benchmarking block, and gauges a system's capability to extract Redbook audio from a CD and convert it to MP3 format. This benchmark is an excellent method of determining not only the strength of a system's optical drive, but also the CPU's number-crunching capability. Replacing our old *Inspire 3D* rendering test, MP3 ripping/encoding is a nod to today's hottest music phenomenon, and is also a great way to hit a number of subsystems with one benchmark.

There are two reasons we chose *MusicMatch Jukebox* to perform this benchmark. First, it uses the Fraunhofer decoder, which is known for its reliability and speed. Second, it's the easiest-to-use ripper/encoder we've ever encountered; it requires just one click to rip and encode an entire CD. Our test extracts the audio files from *Neil Diamond: The Millennium Collection* (348MB of Redbook audio), stores them as WAV files on the hard drive, then encodes them at a 128kbps bitrate,



Mad Onion's 3*Dmark*2000 is our new Direct3D test because it incorporates hardware transform and lighting tests, and scales well with increased resolutions. We run the "action" demo at medium detail to test the graphics card and the CPU.

without error correction. The entire process is timed with a stopwatch; lower scores are better. After the test is complete, we check the quality of the recording, as shoddy hardware will often produce skipping or other errors. If significant errors occur, they are noted in reviews. (After all, Neil wouldn't dig a substandard rendition of his fine work, now would he?)

IMAGE EDITING EDICT

Adobe *Photoshop* is the industry standard for image editing, so it's a logical choice for testing CPU and memory-bus performance. We've upgraded to the latest rev (version 5.5), and switched from a 3.7MB to a 8.1MB test file.

The benchmark runs the test file through an obstacle course of real-world actions that should bring even the burliest of systems to its knees. The test should take place entirely within the confines of system memory, and will only hit the hard drive in rare instances (assuming the rig is outfitted with at least 128MB of memory).

After consulting with Adobe about which Photoshop actions are the most taxing, we developed a more grueling script this time. We now include image resizes and rotations, effects filters, and color palette conversions, combining floating-point, integer, and SSE calls. That's right: The script uses a smattering of SSE calls, and will therefore favor Intel CPUs just a tad. The action script is timed with a stopwatch; lower scores are better.

OPENGL HELL

Choosing *Quake III Arena* as our OpenGL gaming benchmark was a no-brainer. Because Carmack endowed the *Quake III*

Our sexy new *Photoshop* test image was found in Philly's archives. We take this 8.1MB image and apply a smattering of real-world actions to it to determine the merit of a system's CPU and memory bus.

engine with so many bleeding-edge rendering features, we expect this game will make a tortuous videocard benchmark for some time to come—or at least until we revise the benchmarks.

To benchmark systems, we run demomap demo001 at 1024x768 with 32-bit textures. We use the highest possible geometry and texture detail settings. Just loading the demo's texture data requires about 32MB of local videocard memory, and when you count the number of triangles represented by the detailed models and curved surfaces, it's easy to see why *Quake III* is the standard for OpenGL benchmarking. *Quake III* is also one of the only games to support hardware T&L, which we expect to be a standard feature in every videocard coming out in the near future. The demo spits out an average frame rate score; higher scores are better.

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DIRECT3D DECATHLON

Sussing out the best way to test a videocard's Direct3D performance took some effort. Originally, we decided on *Unreal Tournament*, but preliminary testing exposed UT as incapable of scaling at higher resolutions. We turned next to Mad Onion's popular *3Dmark2000*. This benchmark takes advantage of the hardware T&L found in DirectX 7, and includes optimizations for both AMD's 3DNow! and Intel's SSE instruction sets.

Based on 3D Realm's Max Payne engine (a full-fledged, working game engine), the specific benchmark we chose—the helicopter sim—force feeds the 3D card with tons of triangles in the form of detailed scenery. This also tests the advanced DirectX 7 feature set by using dynamic lighting and heavy alpha-blended smoke trails. We run the benchmark at 1024x768 in 32-bit color, using the medium detail settings. The benchmark spits out an average frame rate score; higher scores are better.

CD A-TACH

CD- and DVD-ROM drives always boast an advertised speed rating, but these ratings only refer to the drives' peak performance. Because CAV drives read faster on the outside tracks than on the inside tracks, we use *CDTach* to find the average read speeds across an entire disk. We've used *CDTach* since time immemorial because it accurately reports a drive's capabilities, emulates real-world performance by reading data in 16K chunks, and works on both CD-ROM and DVD-ROM drives. *CDTach* reads from nine different disk locations to account for the CAV speed differential mentioned above, and reports an average performance rating (for example, 21x) as a much more accurate drive rating.

How to Read the Benchmarks

We ran our new benchmarks on a 733MHz Dell Dimension desktop and 500MHz Dell Inspiron notebook to establish "zero points" for our new benchmark charts. These two PCs offer "average acceptable performance" as of May 2000. Scores for new desktops and notebooks will be compared with the scores of our zero-point systems. We also use the desktop zero-point system as a test bed for individual component evaluation.

DESKTOP ZERO-POINT SYSTEM: Dell Dimension XPS B733R: P-III 733MHz Coppermine; i820 chipset; 128MB RDRAM; 32MB GeForce 256 SDRAM videocard; 20.4GB 7200rpm ATA/66 hard drive; 48x CD-ROM drive.

NOTEBOOK ZERO-POINT SYSTEM: Dell Inspiron 7500: mobile P-III 500MHz, 128MB SDRAM, ATI Rage Mobility P graphics chipset, 25GB hard drive, 6x DVD-ROM drive.

Desktop Systems

REAL WORLD BENCHMARKING				
CPU/MOTHERBOARD bootMark	373	196	373	550
WIN9x APPS SYSmark2000 official score	174	44	147	250
HARD DRIVE HD Tach MB/sec	20.2	11.4	20.2	35
CD-ROM CD Tach98 drive rating	26x	12x	26x	40x
MP3 RIP/ENCODE MusicMatch Jukebox sec	275	375	275	175
IMAGE EDITING Adobe Photoshop 5.5 sec	170	260	170	80
DIRECT3D 3D Mark2000 fps	38	0	38	120
OPENGL Quake III fps	34.4	0	34.4	120
			0	

The specific score achieved by the system.

The mid-points denote "acceptable performance" as of May 2000, and are based on the precise scores achieved by our base Dell systems. As we review new systems each month, their benchmark scores will fall either below or above the mark of acceptable performance.

Notebooks

REAL WORLD BENCHMARKING				
CPU/MOTHERBOARD bootMark	266	157	266	375
WIN9x APPS SYSmark2000 official score	105	60	105	150
HARD DRIVE HD Tach MB/sec	11.4	2.8	11.4	20
CD-ROM CD Tach98 drive rating	15.5x	7x	15.5x	24x
MP3 RIP/ENCODE MusicMatch Jukebox sec	405	460	405	350
IMAGE EDITING Adobe Photoshop 5.5 sec	240	300	240	180
DIRECT3D Expendable fps	14.4	0	14.4	30
OPENGL Quake III v3.20 fps	18.8	0	18.8	35
			0	

The more a system outperforms the mid-point system, the further into the green its bar moves. The numbers shown at the high-point are the best scores we expect to see in the next six months.

The more a system underperforms the mid-point system, the further into the red its bar moves. The numbers shown at the low-point are the lowest scores we expect to see in any shipping product.

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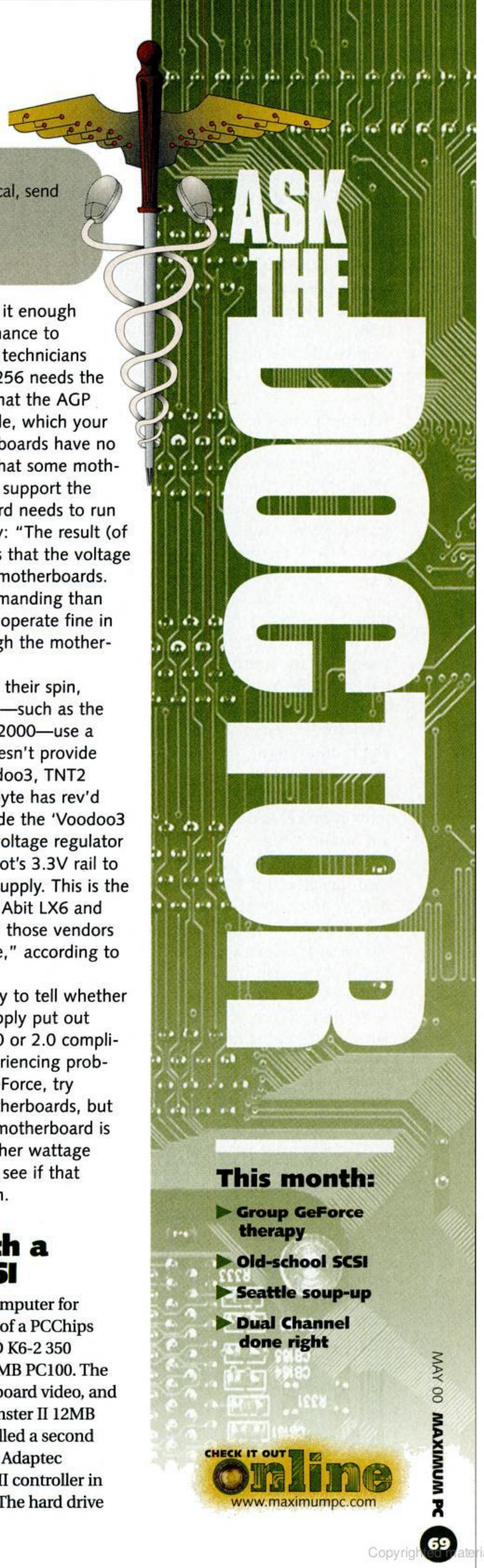
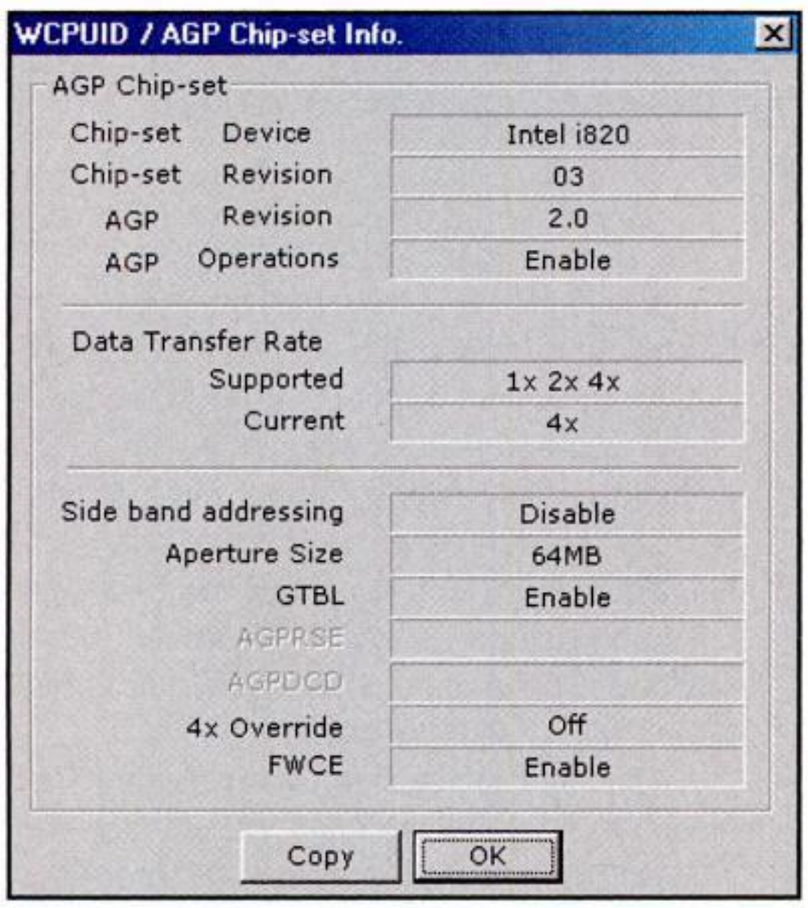


Pining for a more Forceful GeForce

I have a Creative Labs Annihilator Pro GeForce card, and have spent the last few days in news-



Early Athlon boards don't support the high wattage required by GeForce cards. You can check your AGP status using WCPUID from www.h-oda.com.

groups learning that I am not alone when it comes to concerns with GeForce-based video-cards. From what I've seen personally, as well as from what I've read, it seems the GeForce is a very finicky card, with explicit power requirements that must be met in order to assure full functionality. I haven't overclocked my GeForce card, but my system is overclocked (Abit BX6 R2 with Celeron 366MHz on an 83MHz bus for a total of 458MHz). From surfing the net, I know a lot of people are having power consumption problems with GeForce cards (myself included). I am not looking for a solution, I just wish to share my feelings with other readers of the magazine I most respect.

—Jack Minshull

> **I checked the speed and was amazed that the SCSI drive was putting out only 1.5MB per second while the IDE drive was running at more than 6.5MB per second.**

It's no secret that nVidia's numero uno graphics card has problems with certain mother-boards because they can't feed it enough power, but we gave nVidia a chance to address the criticism. Company technicians told the Doc that the GeForce 256 needs the full 6 amps of 3.3-volt power that the AGP spec calls for. (This is in 2x mode, which your Abit BX6 R2 supports. AGP 4x boards have no problems.) Reps at nVidia say that some motherboards out there simply can't support the full dosage of amps that the card needs to run properly. To quote the company: "The result (of using a non-compliant mobo) is that the voltage will drop below 3.3V on those motherboards. Graphic boards that are less demanding than GeForce 256-based boards will operate fine in those motherboards even though the motherboard is out-of-spec."

Creative Labs officials added their spin, saying that some motherboards—such as the Gigabyte 6BXC, 6BXE, and BX-2000—use a linear voltage regulator that doesn't provide enough current to run the Voodoo3, TNT2 Ultra, or GeForce cards. "Gigabyte has rev'd the 6BXE and BX-2000 to include the 'Voodoo3 VGA' jumpers that bypass the voltage regulator and directly connect the AGP slot's 3.3V rail to the 3.3V lead from the power supply. This is the same problem as seen with the Abit LX6 and ASUS P2L97 rev 1.05 for which those vendors offer a fix that uses a jump wire," according to the Creative reps.

Unfortunately, there's no way to tell whether your motherboard or power supply put out enough power to meet AGP 1.0 or 2.0 compliance. If you're experiencing problems with your GeForce, try swapping out motherboards, but if you think your motherboard is fine, borrow a higher wattage power supply and see if that solves the problem.

Stuck with a Sucky SCSI

I recently built a computer for gaming. It consists of a PCChips motherboard, AMD K6-2 350 processor, and 128MB PC100. The mobo has 8MB onboard video, and I installed twin Monster II 12MB video in SLI. I installed a second hard drive with the Adaptec AHA-1542b SCSI II controller in my only ISA slot. The hard drive

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connected to it is an older Quantum PD700. Everything seemed to be working fine. Eventually, I installed *Nuts and Bolts 98* to check the speed and was amazed that the SCSI drive was putting out only 1.5MB per second while the IDE drive was running more than 6.5MB per second. I've checked the jumper settings on the controller card and the drive, and all settings are correct. Is this the all I can get from a SCSI transfer or have I done something wrong?

—Rick Anderson

Your performance numbers sound correct. The problem lies in two areas, both of them attributable to hardware from the Stone Age. First, your drive is the main culprit. That drive is never going to go faster than it was designed to go, which is at SCSI II speeds. At the most, SCSI II is only able to transfer 20MB/sec throughout the entire chain. Hard drives are typically only able to push about one-fifth of the total transfer speed ofthe SCSI protocol. The Quantum PD700 was introduced during Clinton's first term in office, and barely qualifies as a molasses drive.

"The only motherboards that support the Coppermine through 800MHz have a V in the part number."

Second, the ISA bus that houses your card runs at just 8.3MHz and transfers data at 16.6MB/sec max. With this knowledge, it would still seem your drive has all sorts of extra room to breathe, but this isn't the case. Your drive is designed under an old standard, and the components inside it are not designed for transferring data at today's blazing-fast speeds. Heck, your drive runs at 4500rpm and won't keep pace with even a comparable 5400rpm drive, let alone the 7200rpm drives that are prevalent today.

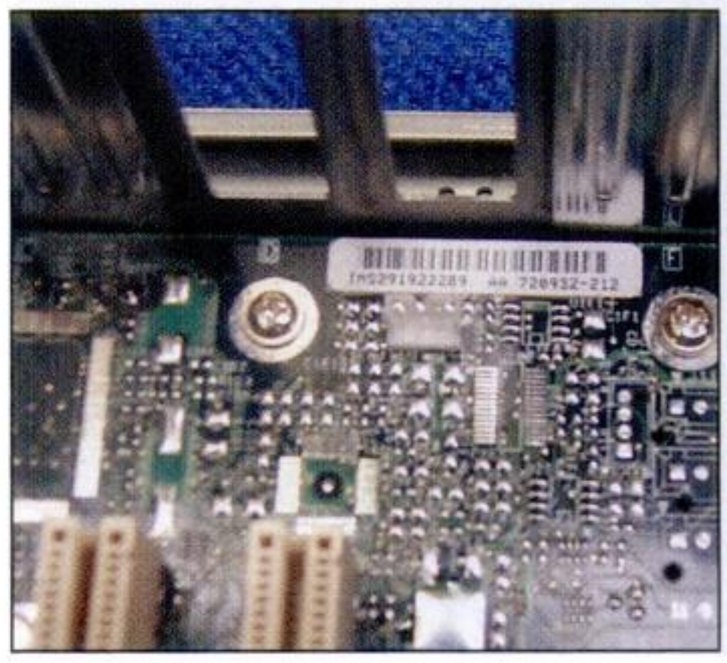
Can you make it go faster? Unfortunately, the answer is probably not. Your best bet is to ditch the drive and controller, and get an Adaptec PCI SCSI controller and a decent 7200rpm SCSI drive.

Sleepless with a Seattle

I have a Dell XPS R450 Pentium II, 128MB RAM, and a 3Dfx Voodoo3 3000. I would like to upgrade to a Pentium III 600 and the new Pioneer DVD. Will I need anything else besides the CPU, such as a BIOS upgrade? I can't seem to find anything on Intel's site.

—elwal

Unfortunately, your box uses the original SE440BX "Seattle" motherboard. The fastest the original Seattle would go is 4.5 x 100, or 450MHz. You can upgrade to a 450MHz Pentium III but that wouldn't net you much unless you use applications that take advantage of SSE. If you're so inclined, you can upgrade to a Seattle II motherboard, which may support Katmai P-IIIs as well as Coppermines, depending on which kind of mobo you get. The SE440BX-2 supports faster Katmai Pentium III, but not Coppermine P-IIIs, but Intel recently rev'd the motherboard line to support the lower voltage requirements of the Coppermines. The only motherboards that support the Coppermine through 800MHz have a V in the part number. When shopping for one, you should be able to look at the label on the outside. If the model number ends with a V, it supports Coppermine. If you don't have the original packaging, you can look at the AA number on the motherboard. Older Seattle 2 boards will have AA numbers that begin with 72, for example, 720930-203. Newer SE440BX-2V boards have AA numbers that begin with a 75, for example, 754558-200.



Seattle mobos with 72 after the AA numbers are old skool. Newer models start with 75, and boards that support Coppermine have a V in the sequence.

We should also note that Intel warns that running a Coppermine in a PC that doesn't support it (even if it boots up) will reduce the life span of that precious CPU. Intel gave the same warning about overclocking though, so take it with a grain of salt.

Another option for those users whose BX boards don't support the lower voltage of the Coppermine is to wait for adapters that will handle the chore.

The Doctor has heard that several solutions are on the way that should let you run a Flip Chip PGA P-III Coppermine without problems. But the price may not be so nice. ✹

second opinions

READERS SHARE THEIR HOME REMEDIES

A Scuzzier SCSI for the BIOSphere

Although the information you gave in regard to the January SCSI question was technically correct, there is a more specific problem related to Windows 98 and Adaptec 3940 and 2940Uws controllers. Microsoft Windows (not the SCSI drivers) seems to have enormous trouble correctly assigning the SCSI BIOS to the correct channel (remember that the 3940 has two SCSI buses).

If the bootable drive is on channel B, and any SCSI device resides on channel A, Windows will usually assign the SCSI BIOS to the wrong channel, creating lockups. To fix this in Safe mode, remove both of the Adaptec drivers, shut the machine down, and put all the drives on Channel A. Boot up and let Windows auto-detect the drivers, then move the bootable drive to channel B. Don't forget to set the Adaptec BIOS to boot from channel B first. :)

This undocumented feature had me stumped for days, and doesn't seem to be well documented. This problem will hit the users of Tyan boards worst, because only channel B has a dedicated Fast/Wide connection that can't be slowed down by the 8-bit bus on the A channel. Hope this helps.

—Brian Weatherill

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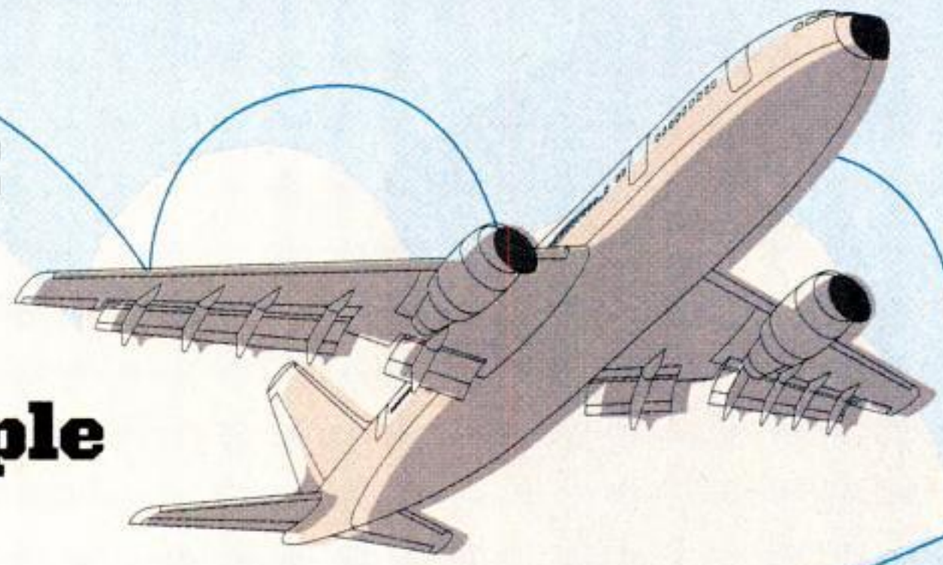

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REVIEWS

LIVING LA VIDA LAB-A!

This month, the Lab was a flurry of activity. Sean had his hands full with videocards and the quad-boot feature, Gordon put the GHz Athlon reference system through its paces, Geoff was surrounded by laptops, and I was occupied with three optical drives and the 1GHz Compaq. Even Editor-in-Chief Philly was in on the action, testing a $2,600 LCD with a TV tuner. We were also busy preparing our new 733MHz Coppermine test systems for the tour of duty that awaits them.

To go along with our new test systems, we've got brand spankin' new benchmarks. We've added an MP3 ripping/encoding benchmark, dumped the 3D rendering test, and added new revs of some old favorites. For more info on our new testing procedures, check out Lab Notes on page 66.

— JOSH NOREM, REVIEWS EDITOR

BEHIND THE BENCHMARKS

This month: CD/DVD-ROM/CD-RW

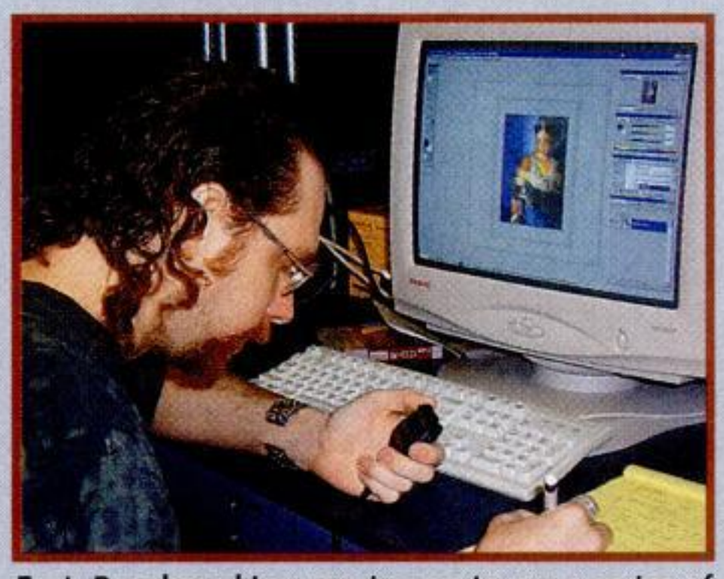
To test a CD or DVD-ROM, we go to great lengths to isolate the drive from the system. First, we set the drive we're testing as the master on the secondary IDE channel. Next, we defeat CD caching by setting the drive's supplemental cache size to small. We also turn off read-ahead capability, close all running tasks, disable any NICs, and turn off autoinsert notification.

We run *CDTach* three times consecutively, and record all scores using a 16k weighted average, meaning data is read in 16k chunks to emulate real-world multimedia and desktop application performance. When testing CD-RW drives, we always put the source drive and recorder on separate IDE channels to allow both drives to fully stretch their legs during testing. Putting both drives on the same channel can work, but can cause slowdowns and even buffer underruns.

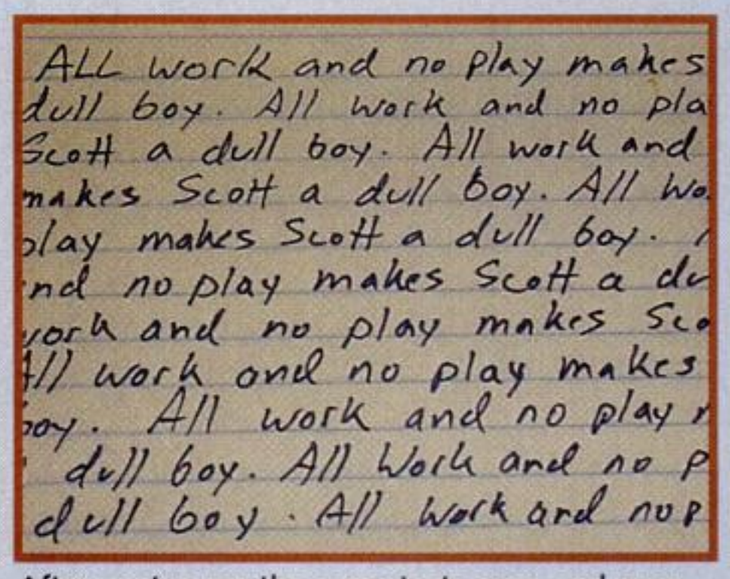
Benchmarking: Fiction vs. Fact!

Benchmarking a 1GHz machine in *Quake III* qualifies as work for us, but it's not as easy (or fun) as many of you may be led to believe. To separate fact from fiction, we broke down what you may think our job entails with what we actually do on a daily basis. Don't get us wrong; we love our work. But as you can see by Scott Tarr's benchmarking notes, eventually we all become "lab loopy."

Fiction: Every day, we play *Unreal Tournament* in the Lab, flanked by vixens. Due to San Francisco's balmy climate, we usually wear Hawaiian shirts and drink margaritas at lunch.



Fact: Benchmarking requires us to run a series of tests that we've seen a thousand times before. Timed tests require us to sit patiently with stopwatch in hand, waiting...waiting...



After you've run the same tests over, and over, and over, you begin to get a little...who said that? Who's there? What do you want from me?

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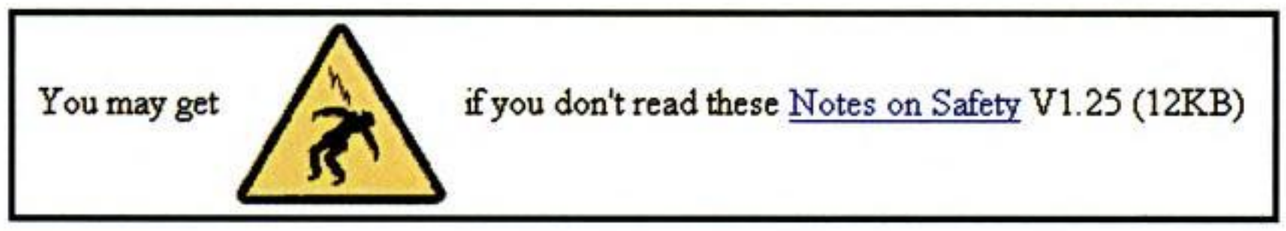
A behind-the-scenes look at the Maximum PC Lab and the gearheads who work in it.

20 PRODUCTS REVIEWED!

RIGHTEOUS WEB SITE: REPAIRFAQ.ORG

You know you've entered a hardcore tech site when you hit a 300-section repair FAQ. But this site is all-FAQ, all the time. The CRT monitor repair FAQ at **www.repairfaq.org/repair/f_monfaq.html** offers an awe-inspiring bounty of raw monitor insight. It's also an addictive page-tuner, even if you have no intention of fixing your tube (assuming, of course, that you're an unabashed tech geek, kinda like we are). You'll learn about interlacing, degaussing, geometry, deflection yokes, and everything else CRT-related. Awesome!

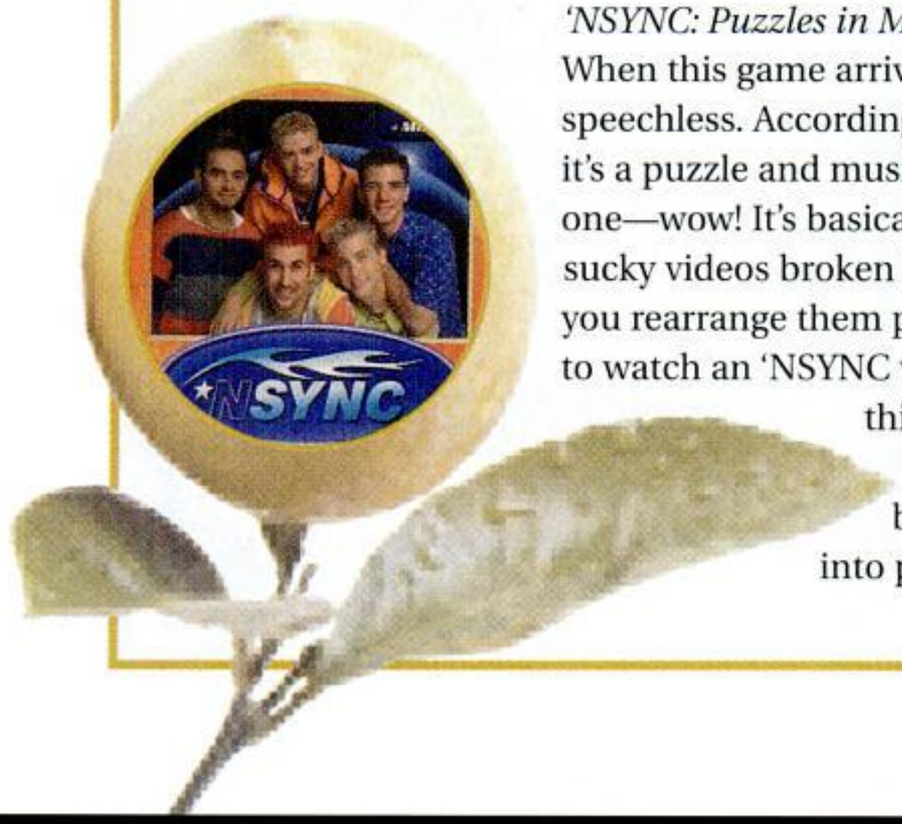


PUTTING DELL THROUGH HELL, PART TWO

Our torture testing on Dell's perfect 10 box has begun in earnest, with a three- month CPU workout. We've been running SETI@Home 24/7 for three months straight, but so far the Dell's holding up just fine. We've even run as many as seven SETIs at once, but the Dell hardly broke a sweat.

We've also been testing the weakling 200-watt power supply many readers have griped about. There were only two slots open (one RIMM and a PCI), so we filled them with 128MB of RDRAM and an Adaptec 2940UW SCSI controller connected to a 10,000rpm Seagate hard drive. We ran a *Quake 3* loop while burning CDs, ran *SYSmark* while copying 648MB of data to the hard drive, and even ran a looping *HDTach* while running *Quake 3* in a loop. Unfortunately, the Dell hasn't cracked—yet.

Lemon of the Month



'NSYNC: Puzzles in Motion

When this game arrived, we were speechless. According to the box, it's a puzzle and music video all in one—wow! It's basically a bunch of sucky videos broken into pieces; if you rearrange them properly, you get to watch an 'NSYNC video clip! We think it would be more fun to break 'NSYNC into pieces.

CHECK IT OUT **Online**

www.maximumpc.com

Benchmarking: Full Disclosure

Please check out page 66, for an explanation of our benchmark policies. Or dial up **www.maximumpc.com/benchmarking** for the complete lowdown on the *Maximum PC*'s benchmarking strategies.

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Compaq Presario 5900Z-1GHz

CALL IT A COMEBACK

Sadly, Compaq has given us little to complain about with its GHz box.

PLUSES
- Gigahertz—'nuff said
- Klipsch Speakers
- Sweet components
- Sufficient cooling apparatus

MINUSES
- Case is weird, looks silly
- Middling performance vs. 850 Athlon
- 145-watt power supply

When Compaq informed us that a top-secret Athlon machine was on its way to The Lab, we were curious but cautious, since the last AMD-based system we reviewed from Compaq (Presario 5861, October 1999) received a mediocre 5 verdict. Regardless, we invited Compaq to "bring it on." The next day, the first retail GHz PC we'd ever seen arrived at our door, and it quickly became clear that Compaq had done everything in its power to make sure this system didn't receive a tongue-lashing like the last one.

For starters, this rig addresses every major complaint we had about the last system, which was an Athlon 600. We complained about the lack of a storage sub-system, but the 5900 has both an 8x/4x/32x CD-RW drive and a 100MB Zip drive. We also felt the 13GB hard drive on the Presario 5861 was too small. Compaq heard our call and outfitted the Presario with a 40GB Maxtor DiamondMax, the biggest and fastest hard drive on the market. We bitched about the choice of a Voodoo3 card for graphics; Compaq replaced it with a DDR GeForce. Our only major complaint about this system's components is the unbelievably wimpy 145-watt power supply. Although the system ran smooth as silk throughout testing and proved itself to be very stable, a power supply of that caliber makes future upgrade possibilities questionable.

To cool off this hottie of a 1GHz processor, Compaq used a massive heat sink and mounted twin fans onto the CPU. Compaq even spliced and tightly wrapped one of the IDE cables, allowing better airflow from the front of the case.

The most stunning feature of the Presario is that after bootup, nothing is running the background—nothing! There's not even a volume control in the taskbar, and hitting Ctrl+Alt+Del shows only one program running—*Explorer*. Kudos, Compaq, but if retail systems differ one iota from this config, we'll make a big stink about it.

How does the Presario perform? In a word, average. To contextualize its score, we compared it with two other systems: this month's 1GHz AMD reference box and a Cybermax 850MHz Athlon system. The AMD system uses the burly VIA KX133 chipset; the Compaq deploys an AMD/Via combo, and the Cybermax uses the age-old AMD 750 chipset.

UNDER THE HOOD

THE BRAINS

CPU	AMD Athlon 1000MHz
L2 cache	512K closely coupled, 333MHz (1/3 core speed)
RAM	256MB PC100 SDRAM (512MB Max)
Motherboard	FIC SD11, AMD 751/VIA chipset
Drive bays	Three 5.25-inch (one open), two 3.5-inch
I/O ports	Four USB, one parallel, one serial, two IEEE 1394

DISPLAY

Video	nVidia GeForce, 32MB DDR SDRAM
Monitor	Compaq MV920 19-inch (18-inch viewable, 0.26mm dot pitch)
Res/Refresh	75Hz@1600x1200

STORAGE

Hard drive	Maxtor DiamondMax 40GB ATA/66 7200rpm
DVD	Pioneer DVD-114 10x
CD-RW	LG 8x/4x/32x
Removable	1.44MB floppy, Zip 100

SOUND

Soundcard	Sound Blaster Live! Value
Speakers	Klipsch ProMedia V.2-400

NETWORKING

Fax/modem	V.90 56K PCI fax modem/G.lite DSL 6Mb, Accton EN1207D PCI Fast Ethernet

THE BUNDLE

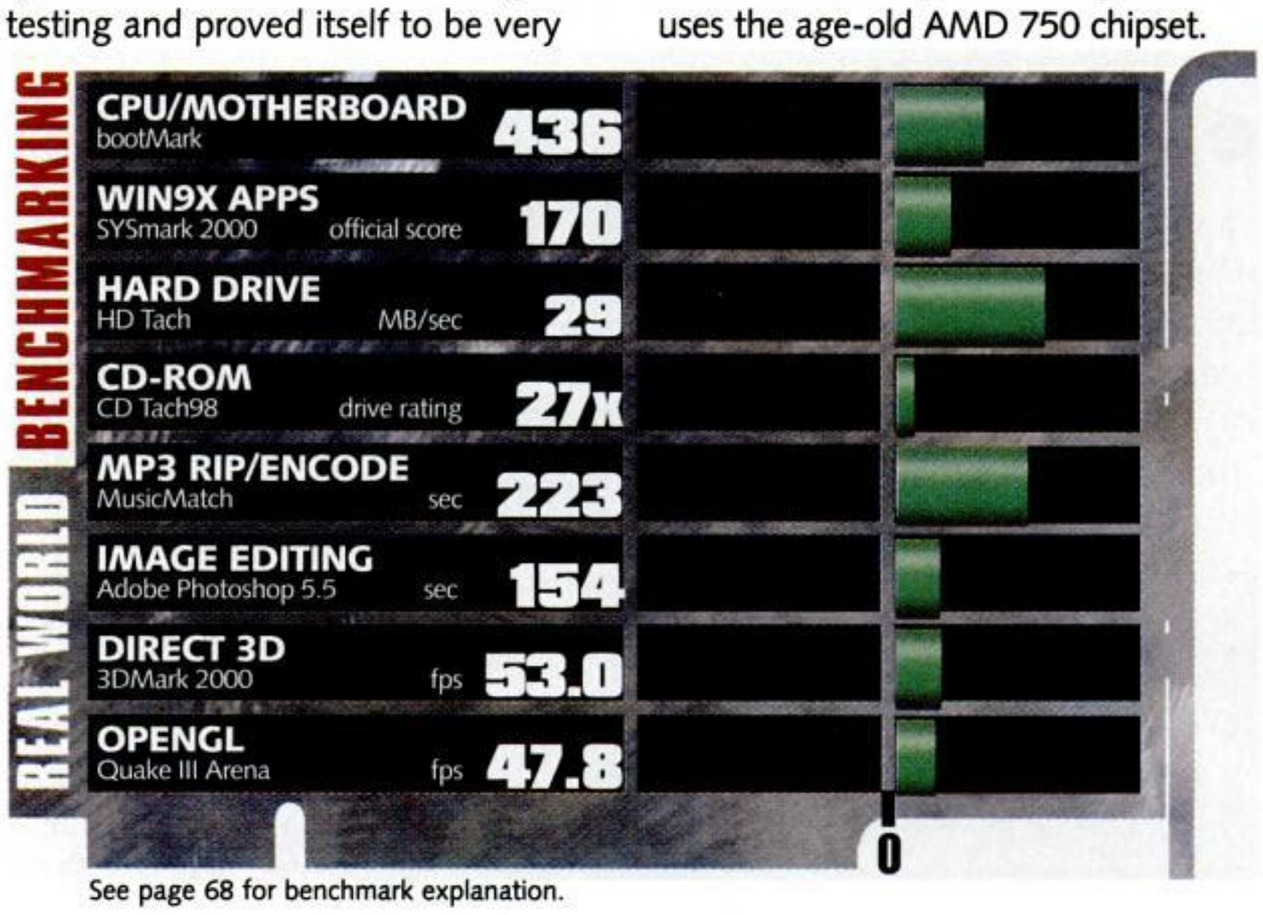
McAfee *VirusScan*, RioPort *Audio Manager*, MGI *VideoWave III*, CeQuadrat *CD! Backup*, CeQuadrat *just! Audio*, CeQuadrat *just! Data*, Winzip

BOOT 0:53 DOWN 0:02

The AMD box is clearly the fastest of the three but we saw the most surprising difference in benchmark scores during our toughest test, *SYSmark*. The Presario scored 170, the AMD scored a phenomenal 182, and the Cybermax rung up a 166. The Compaq tied the Cybermax in our *Photoshop* benchmark, and fell short of AMD's box by 16 points in *bootMark*. But the Compaq absolutely dominated the *HDTach* benchmark; its Maxtor 40GB drive ripped an incredible 29MB/sec average read speed.

Although the Presario didn't soundly outrun the 850MHz Athlon, and its trouncing by AMD's reference box disqualifies it from Kick Ass status, it's still a major improvement over past systems.

—Josh Norem



See page 68 for benchmark explanation.

MAXIMUM PC VERDICT

$4,000 with monitor ($3,582 without monitor) | Compaq
www.compaq.com
RS www.readershop.com
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8

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EXPANSION NOTES

There's not a whole lot to add, but a total of five PCI slots (no ISA) allows some upgradeability. Only two PCI slots are full, but choosing between the modem and the NIC will free up one more.

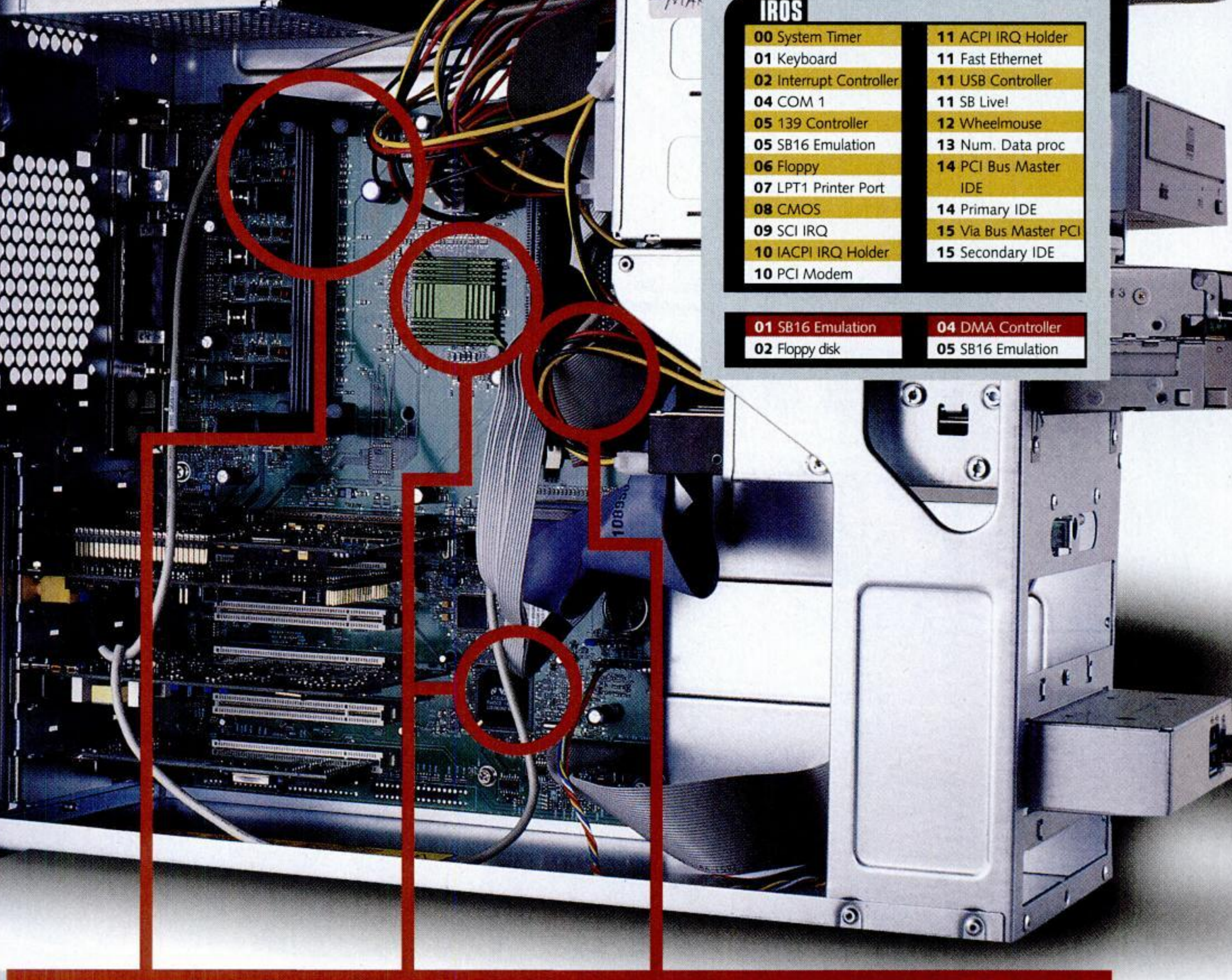
EXPANSION MAP

AGP: GeForce
PCI: SB Live! Value
PCI: Open
PCI: 56K modem
PCI: Open
PCI: 10/100 NIC

IROS

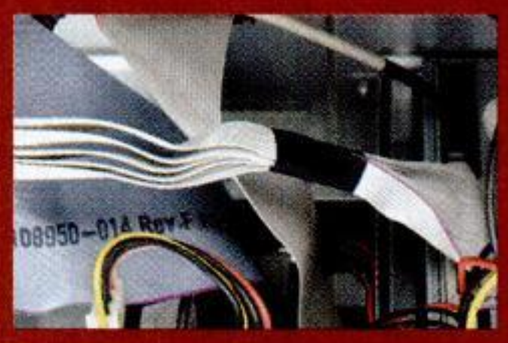
00 System Timer	**11** ACPI IRQ Holder
01 Keyboard	**11** Fast Ethernet
02 Interrupt Controller	**11** USB Controller
04 COM 1	**11** SB Live!
05 139 Controller	**12** Wheelmouse
05 SB16 Emulation	**13** Num. Data proc
06 Floppy	**14** PCI Bus Master IDE
07 LPT1 Printer Port	**14** Primary IDE
08 CMOS	**15** Via Bus Master PCI
09 SCI IRQ	**15** Secondary IDE
10 IACPI IRQ Holder	
10 PCI Modem	

01 SB16 Emulation	**04** DMA Controller
02 Floppy disk	**05** SB16 Emulation



Go-Go-Gigahertz AMD's 1GHz CPU is made from the K75 core that originated with the 700MHz chips. It has the same 128K of L1 cache and 512K of L2, but the L2 was bumped down to 1/3 core speed for the 1000MHz chips.

Ole faithful In order to be the first vendor to sell a GHz system at retail, Compaq chose to stick with an AMD-based chipset rather than going with the immature VIA KX133 chipset.



Serial ATA? Not quite, but it's still cool. To improve airflow from the front of the case, Compaq spliced the IDE cable that connects the optical drives, reducing it to one-fourth its normal size.

Bring the Noise What more can we say about the Klipsch ProMedia, other than the perfect 10/Kick Ass rating we gave them in January?

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Palm IIIc

SEE THE (COLORED) LIGHT

After long resisting the siren song of a color display in favor of longer battery life, Palm has finally succumbed with the IIIc. But what a way to go. While color isn't essential to the basic PIM functions of a PDA, once you've experienced it, you won't want to go back.

The IIIc's active-matrix TFT display is capable of displaying a fixed palette of 256 colors, and the included *Album To Go* software is a perfect way to demonstrate the new feature's appeal. A simple drag-and-drop interface converts any JPEG to a Palm-compatible resolution (160x160) and color depth (8-bit), and then cues the image for downloading into the IIIc the next time the unit is synched. While some dithering occurs with complex patterns and high-resolution files, it takes only moments to pull together a great pocket album.

The IIIc display's resolution is coarse compared with the color screens of its CE counterparts, and we're hoping Palm packs more pixels into its future displays. The screen itself is bright and visible in direct sunlight as well as indoors, thanks to the fixed backlighting. An on-screen brightness slider allows on-the-fly adjustments.

Of course, all this color and backlighting exacts a toll on battery life. To handle the increased power demands, the IIIc has adopted the built-in, rechargeable Lithium-Ion battery first employed in the Palm V model. This battery quickly recharges when the unit is placed in the sync cradle, although not as quickly as the "few minutes" Palm claims in its literature; a full recharge takes a few hours. Palm also says that the battery delivers "over two weeks of normal usage," but our testing put that number closer to two or three days of intensive use.

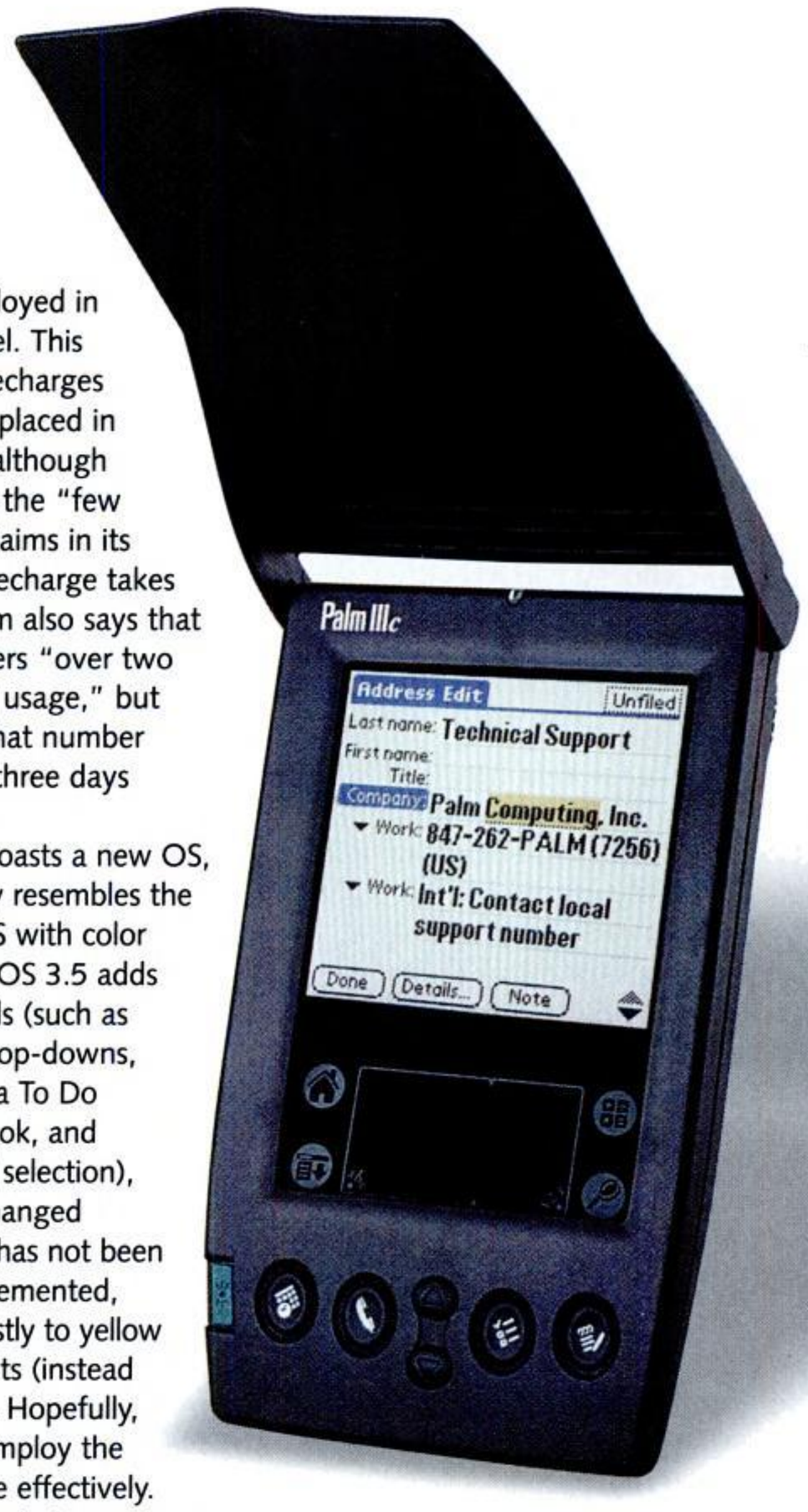
The IIIc also boasts a new OS, which predictably resembles the previous Palm OS with color added. The new OS 3.5 adds a few small details (such as one-tap menu drop-downs, masked records, a To Do list in the Datebook, and double-tap word selection), but remains unchanged otherwise. Color has not been aggressively implemented, and is limited mostly to yellow selection highlights (instead of reversed text). Hopefully, future revs will employ the new feature more effectively.

Under the hood, the IIIc has 8MB of memory available for parking your apps and data. We found that the *Album To Go* app, along with about 135 JPEGs, chewed up about half of our allocated memory, but we thank our lucky stars that Palm has finally acknowledged the necessity of including more than 2MB or 4MB of memory. Driving data around the IIIc's memory is a 33MHz Dragonball VZ RISC processor from Motorola. While zippy in most standard black-and-white apps, the system gets congested when more demanding color calls, resulting in noticeable (but not annoying) draw delays.

A brief stint with any screen-intensive arcade game reveals another difference on the new display: a soft touch. The IIIc is almost mushy to the touch, which takes some getting used to. And the new material seems to accumulate smudges more readily.

But just as it would seem inconceivable for any modern PC owner to surrender his or her color monitor, once a PDA owner has driven a color screen, there's no going back. The IIIc is Palm's first step in this direction, and by making smart power decisions, it's a step in the right direction. Now add the Palm VII's wireless Web access and 8MB more memory, and significantly update the OS (VIIcx?), and we'll award a Kick Ass sight unseen.

—Brad Dosland



PLUSES
- Bright 8-bit color display
- 8MB of memory
- Bundled image app
- Built-in Lithium-Ion battery

MINUSES
- Coarse resolution
- Mushy screen
- Same old OS
- Color is seldom implemented

Under the black case (reminiscent of IBM's Palm units) lurks 256 colors of PDA pleasure.

Flower Power: With the *Album to Go* app, the new Palm is a pocket photo album.

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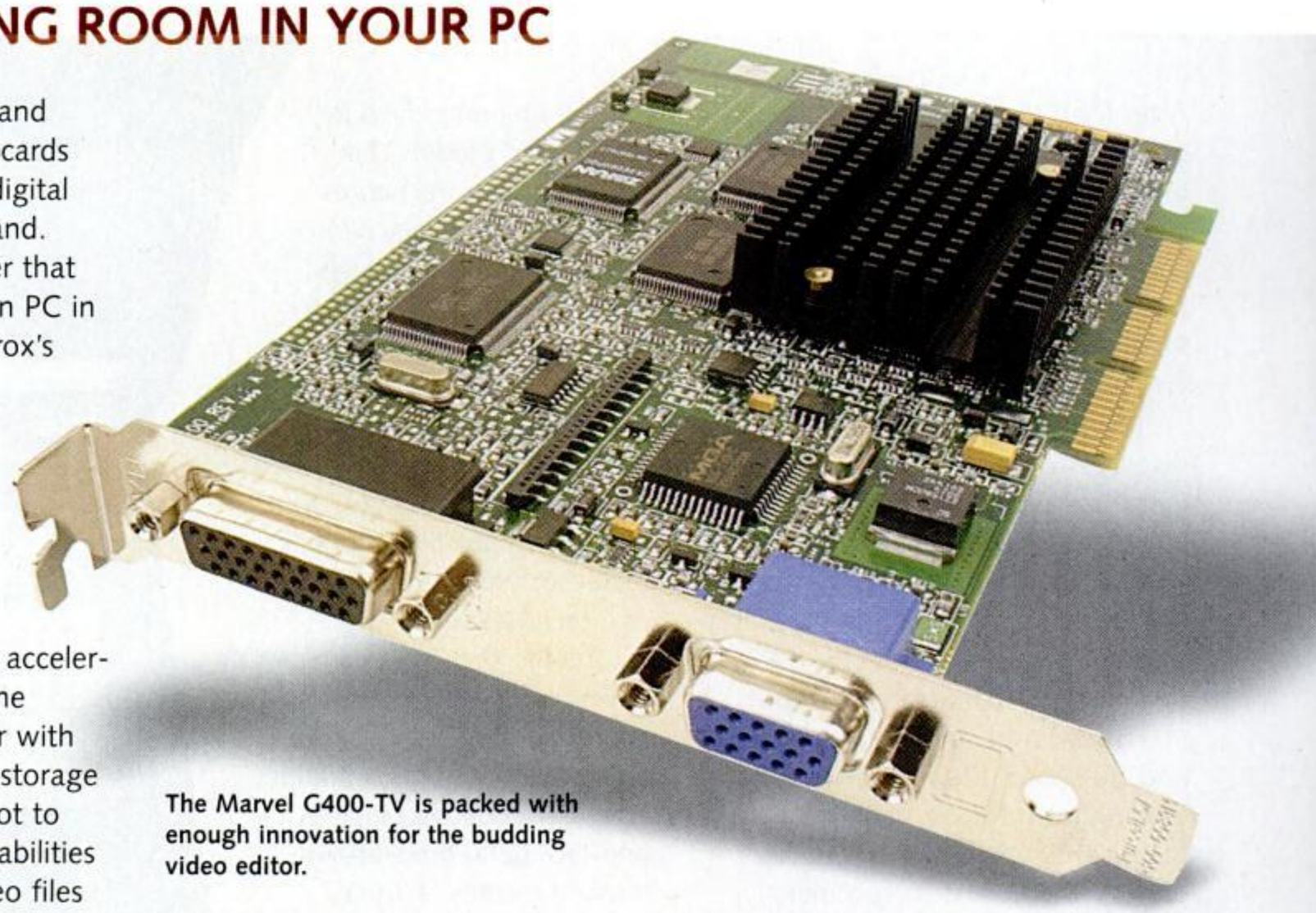
VCR Videocards

PUT YOUR LIVING ROOM IN YOUR PC

With the popularity of Tivo and ReplayTV, you'd think videocards that turned your PC into a digital VCR would be in high demand. Especially when you consider that the Tivo is just a pared-down PC in a pretty package. Both Matrox's **Marvel G400-TV** and ATI's **All-in-Wonder 128 Pro** have TV tuner, video capture, TV-out, and VCR functionality that matches and exceeds the versatility of the Tivo. And both bring the additional benefit of 3D acceleration. When you combine the Marvel or the All-in-Wonder with the expandability and huge storage capacities that PCs offer—not to mention the broadband capabilities that make sharing large video files possible—it seems silly that the Tivo gets all the attention.



The Marvel G400-TV is packed with enough innovation for the budding video editor.

128 PRO

PLUSES
- Excellent TV tuner and software VCR features
- On-the-fly MPEG-2 compression
- Small break-out box

MINUSES
- Poor 3D performance
- Software video compression doesn't scale well with slower CPUs

G400-TV

PLUSES
- Innovative DualHead TV-out
- Powerful video editing package
- Hardware-assisted video compression

MINUSES
- Below average 3D performance
- TV Tuner and digital VCR software not as innovative as ATI's

Of course, the Marvel and the All-in-Wonder aren't self-sufficient boxes like the Tivo; they're add-in videocards that require a PC. They aren't designed to exclusively use a TV and neither card comes with a remote—shortcomings that hold them back from adoption by the average consumer. The ATI and Matrox cards aren't as easy to use as a Tivo, but ATI makes the best attempt by integrating MPEG-2 encoding and decoding with VCR-like software. Using ATI's *Multimedia Center*, you can program the All-in-Wonder 128 Pro to handle complex recording schedules, and capture video in a variety of formats, from raw uncompressed AVI to fancy-schmancy MPEG-2. It can even pull off the Tivo's much-ballyhooed time shift, which lets you rewind the program you're currently watching while still recording the remainder of the show.

The Marvel G400-TV and the All-in-Wonder 128 Pro put all of their composite, S-video, and RCA audio-in connections into breakout boxes, but while the Marvel (top) puts all of its outs in the same box, the All-in-Wonder (bottom) leaves them at the back of the card.

Video Capture

Video capture on the All-in-Wonder 128 Pro is handled by ATI's Rage Theater chip. The card doesn't do hardware compression like the Marvel, but uses the Ligos GoMotion software encoder to crunch captured video. With a software encoding engine, the All-in-Wonder gains flexibility in recording formats, but leans heavily on the CPU to compress video on the fly. This means that you can capture and encode AVIs at smaller resolutions and compression ratios, but you need a 500MHz Pentium III for full MPEG-2 encoding at 640x480.

On the other side of the capture fence sits the Marvel G400-TV, which manages, with its hardware motion JPEG (MJPEG) compression, to capture high-quality video on everything from a 350MHz Pentium II on up. The Zoran MJPEG chip compresses captured video into a proprietary format at resolutions up to 704x480, allowing the Marvel to handle the most difficult video encoding tasks with nary a dropped frame (and without tapping the CPU). Unfortunately, MJPEG video eats up a lot of hard drive space—we're talking at least 90MB for each minute of video. This compares favorably to the All-in-Wonder's AVI compression rates, but not its 25MB per minute MPEG-2 compression. Of course, space isn't everything. Matrox's MJPEG compressed video has noticeably better visual quality than ATI's software MPEG-2 compression.

Both cards come with video editing software that lets you splice together your captured video clips to create movies. ATI includes Ulead *Video Studio 3.0*, an easy-to-use editor that doesn't have the advanced features of the Avid *Cinema* video editor included with the Marvel. But if you're just looking to piece together your video clips and apply a few transitions you probably don't need *Cinema*'s storyboard and sophisticated output features. The Marvel also includes a software transcoder that converts captured video to MPEG-2 for those of you who don't want to devote an entire hard drive to video capture.

Video Playback

While sporting some strong video playback features, the Marvel

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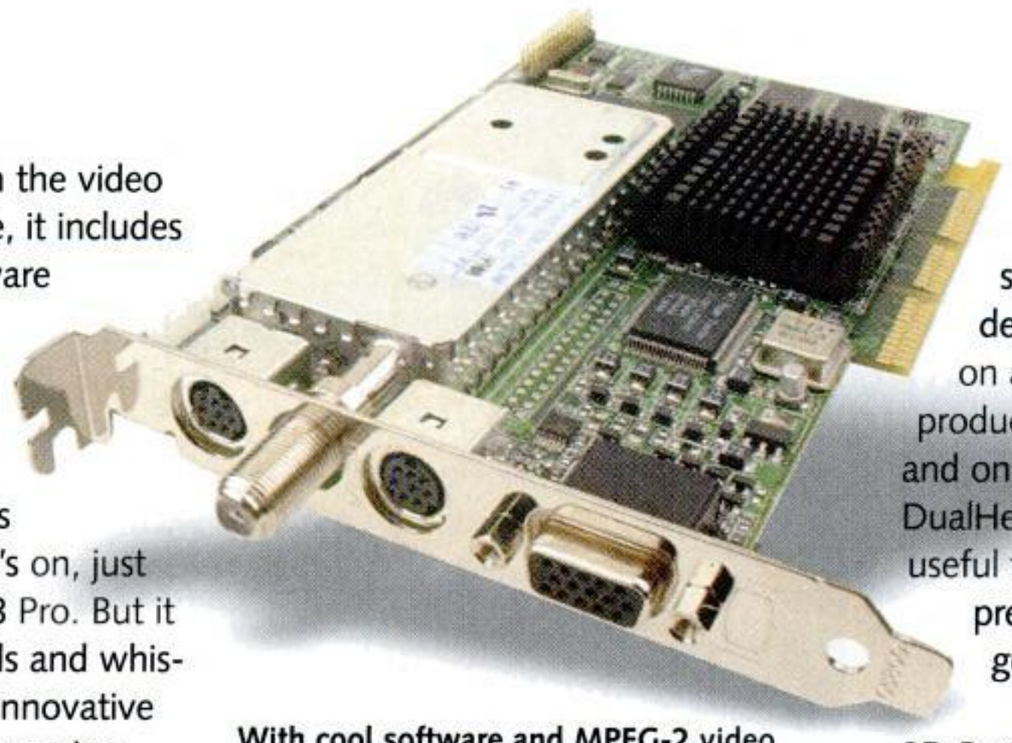
G400-TV focuses more on the video editing side of things. Sure, it includes Matrox's *PC-VCR*, a software remote control that schedules program recording, and a multi-channel preview that searches available channels for a quick glance at what's on, just like the All-in-Wonder 128 Pro. But it doesn't have the extra bells and whistles of the ATI card. With innovative features such as the TV Magazine, which creates a transcript out of closed captions and screenshots, video wallpaper, and excellent search capabilities that notify you when a key word is picked up in a TV program, ATI's TV tuner is just plain cool.

Both cards deliver excellent video image fidelity and they play DVDs like nobody's business, without any noticeable color dithering or tearing problems. Taking advantage of four-tap video scalars, the Marvel and the All-in-Wonder preserve visual quality while resizing the overlay window, making movies watchable from postage-stamp-size to full screen.



With cool software and MPEG-2 video capture, the All-in-Wonder 128 Pro is a feature-rich videocard VCR.

However, ATI gets a leg up on Matrox with hardware support for both motion compensation and indiscrete cosine transform (iDCT), lightening the MPEG-2 decoding load from the CPU.

If you want to watch your DVDs on the big screen, though, you're in for a real treat with the Marvel G400-TV. Using the same DualHead feature that allows the Millennium G400 to power independent displays, the Marvel kicks it's composite and S-video out a TV without making you disable or drop the resolution of your monitor. In conjunction with Win98's multiple display support, you can extend your desktop or play full-screen video on a TV while doing something productive at a different resolution and on your monitor. The Marvel's DualHead TV output is especially useful for video editors who want to preview how the final output is going to look.

3D Performance

As our benchmarks show, you shouldn't buy either one of these cards if you want the best frame rates in *Quake III*. The All-in-Wonder 128 Pro falls well below the curve in our OpenGL benchmarks, and the Marvel G400-TV posted decent scores by using Matrox's TurboGL mini-client drivers. Both cards had ho-hum performance marks in Direct3D, with the All-in-Wonder taking advantage of its 32MB of onboard memory to run 32-bit color games at higher frame rates than the 16MB Marvel. The Marvel kicked the All-in-Wonder's ass in our new graphics application benchmark, confirming the board's strength in content creation.

Beyond middle-of-the-road game performance, the Marvel and the All-in-Wonder have one serious drawback: Any serious videophile is going to use FireWire for his DV needs, and neither card supports FireWire video capture. Once you go beyond the dabbling stage of video editing, the lower resolution video capture and TV-out of the Marvel G400-TV and All-in-Wonder 128 Pro make for limited applications.

When people talk about convergence, they normally think of bringing the PC into the living room. But these cards put the living room into your PC.

—Sean Downey

BUNDLED SOFTWARE

Marvel G400-TV
Win98 | NT 4.0 drivers
Matrox *PC-VCR Remote*
Avid *Cinema* | Ulead *PhotoExpress 2.0*
Tonic Trouble

All-in-Wonder 128 Pro
Win98 | NT 4.0, and Win2000 drivers | ATI *Multimedia Center*
Ulead Video Studio
Digital Immersion *Merlin VR* | *Heavy Gear 2*
Need for Speed High Stakes

DARE TO COMPARE

	MARVEL G400-TV	ALL-IN-WONDER 128 PRO
AGP Support	Full AGP 2x	Full AGP 2x/4x
Clock Speed	126MHz bus / 168MHz memory	125MHz bus / 142MHz memory
Local Memory	16MB SGRAM	32MB SDRAM
RAMDAC	300MHz	300MHz
Max 32-bit Resolution	1600x1200	1600x1200
Max 16-bit Resolution	1600x1200	1600x1200
Refresh Rate at 1280x1024	114Hz	100Hz
Max video capture resolution	704x480	720x480

BENCHMARKS	MARVEL G400-TV	ALL-IN-WONDER 128 PRO
Quake III 1024x768 32-bit color	**34.9fps**[1]	20.9fps
Half-Life 1024x768 16-bit color	**59fps**[1]	41.5fps
Expendable 1024x768 16-bit color	46fps	**52fps**
3*DMark*2000 Game 1 (medium) 1280x1024 16-bit color	**25.4fps**	22.5fps
3*DMark*2000 Game 1 (medium) 1280x1024 32-bit color	17.2fps	**18.1fps**
*SYSmark*2000 Graphics Apps 1600x1200 16-bit color	590	568

NOTES: Benchmarked on our Dell 733MHz Pentium III test system using version 5.41 of the Matrox drivers, and version 6.30 of the ATI drivers. V-Sync is enabled in every benchmark but *3Dmark2000*. Bold indicates the best benchmark score. 1 Benchmarked using version 1.00.002 of the Matrox TurboGL driver.

MARVEL G400-TV 8
$299 | Matrox
www.matrox.com
RS www.readershop.com
877.751.7467 ID#0511

ALL-IN-WONDER 7
$299 | ATI | www.ati.com
RS www.readershop.com
877.751.7467 ID#0512

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PC Private Dicks

SPYING SOFTWARE IS ONLY WRONG IF YOU GET CAUGHT

KEYLOGGER PLUSES
Compact
Low CPU utilization

MINUSES
Low on features
Shows up in the uninstall menu

SPECTOR PLUSES
Secret pictures of your PC!
No-muss configuration

MINUSES
Chokes game play

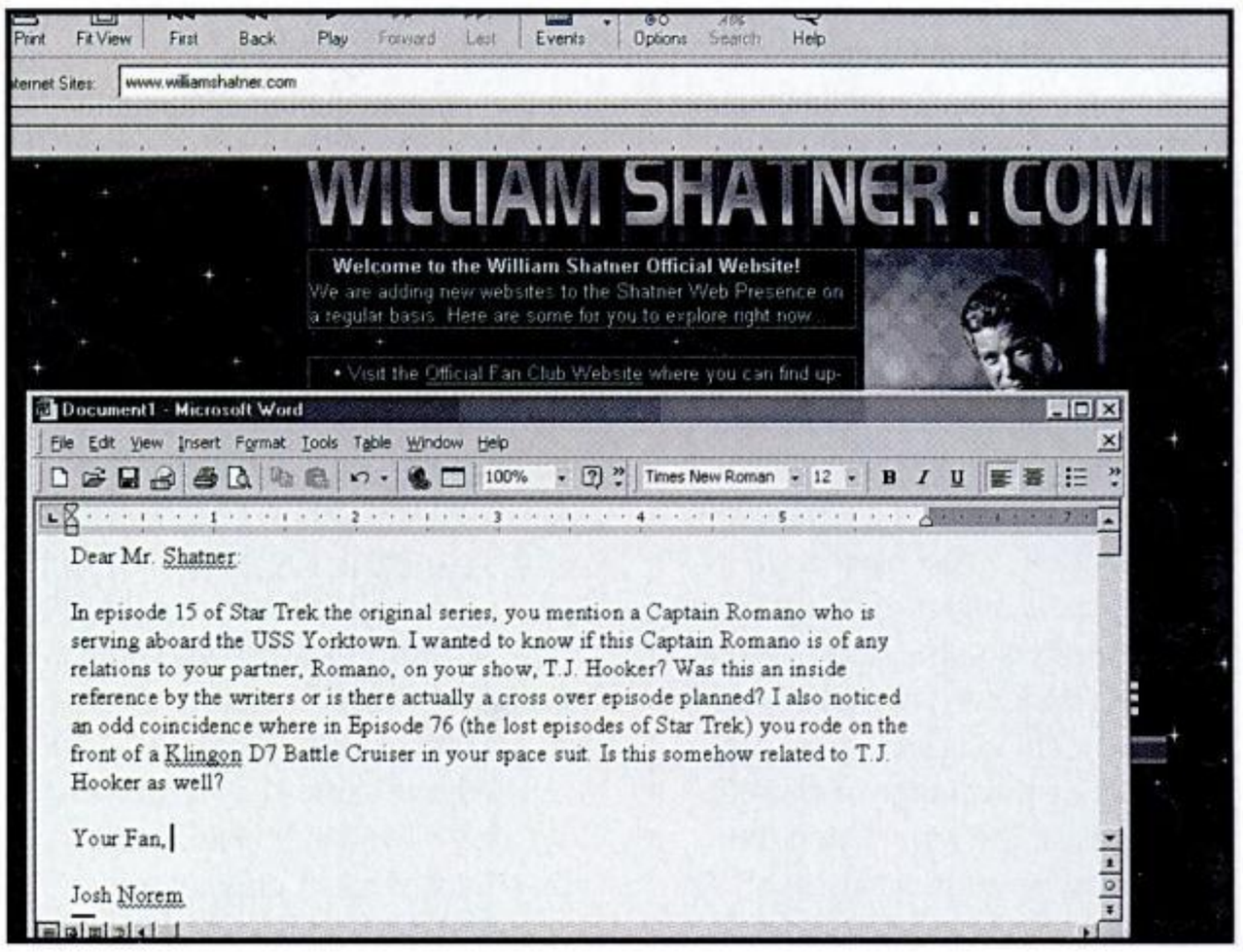
INVESTIGATOR PLUSES
Remote-control spying
Best reporting tool

MINUSES
Tougher learning curve
No way to ensure you've uninstalled it

Mission: Your assignment, should you accept it, is to find out which roommate is using your computer without your permission.

Challenge: The roommate is an adept user and erases all traces of his handiwork, but you know something is up. The first tip-off was the grime he left on the mouse, but the notepad entry he left that read "What's the frequency, Kenneth?" was the final straw. Is your roommate a Manchurian candidate using your computer to send messages to his KGB handlers, or is he reading your intimate fan letters to William Shatner?

Solution: Q branch will equip you with three deadly tools you can use to track down the scoundrel. Select the tool you think bests suits your mission.



You never know what icky things you could unearth when using Spector.

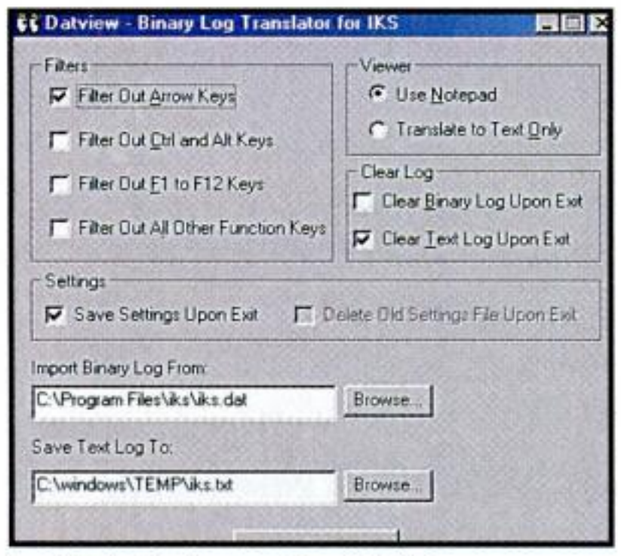
Invisible Keylogger Stealth

Invisible Keylogger Stealth is a basic spy kit that enables you to monitor every keystroke a person makes—and we mean every keystroke. The program even warns you about its invasiveness. The manual states, "*IKS* starts itself at the very early stage of Windows 95/98 initialization. The log may contain confidential information, such as your Windows login password, and every e-mail message and document you type. Be careful with your log!" Yeah, like we're using the log to monitor ourselves. As an exercise in futility, this warning ranks right up there with the copyright infringement statement that appears when you fire up *Napster*.

IKS installs a virtual device driver that intercepts keystrokes at a very low level in the OS. It will even record a three-finger salute, or anything typed in a DOS box run from within Windows 98. The application is also the tiniest in this roundup, requiring the least amount of configuration. To start spying, simply install the program on a PC, let people use the machine, and view the system's log later. In fact, *IKS* has such a small footprint (700K), and is so easy to install, you could theoretically slip it onto a single disk, don a tux, and wreak havoc while sipping a martini at the nearest foreign embassy soirée.

While *IKS*' diminutive size and easy configuration will appeal to some, the program is somewhat feature-poor. It's designed for one purpose and one purpose only: capturing keystrokes on a machine you can access. If you want to know which web sites a person is visiting, *IKS* won't do.

If you're really trying to be stealthy, you'll be happy to hear that running *IKS* during such games as *Unreal Tournament* didn't cause any dropped frames, since anything that gets users curious about performance problems may get them to root around and discover your surreptitious actions. But *IKS* is fairly easy to locate on a machine. While the program doesn't show up as a running task in Windows, it does show up in the Add/Remove Programs menu under the name "*IKS*." Most would overlook it, but it's a fatal flaw in terms of true stealth capability. Still, *IKS* has its uses. For those who have strict mission requirements or are looking to go undetected when monitoring a PC used for gaming, it's the best tool available.



***Invisible Keylogger Stealth* is bare on options, but what it does, it does well.**

Spector

Spector installs just as easily as *IKS* does, but dishes up a lot more dirt. It can capture keystrokes just like *IKS*, but its forte is taking screenshots, giving you visual proof of your target's activities. *Spector* runs in either "visible" mode, in which the target knows he or she is being watched, or in ultra stealth mode, in which the user has no idea surveillance is taking place. Once running, *Spector* proceeds to snap pictures of your desktop at timed intervals.

Spector allows you to select how often and at which color depth you

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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want pictures to be taken. It will even take shots in 32-bit color if your graphics card supports it. But we recommend the default 4-bit grayscale for optimum performance, because it won't tax your system but will provide sufficient detail to ascertain your target's activities. The saved images are highly compressed, but text isn't distorted at all, making it a snap to read other peoples' e-mail.

Possibly the best feature of *Spector* is that once the app is loaded, it's almost impossible to detect. It doesn't show up in the task manager or the add/remove list; it can only be called up using a keystroke sequence that you can set. Even a search for files created that day won't yield any record of the recently snapped pictures, because *Spector* even goes so far as to stamp varying dates on data files in order to prevent such discovery. You can even change the file extension that the program uses for the images. In our testing, we were unable to locate a *Spector* directory or any running DLLs on a machine we knew was running the application, and we couldn't disable the program through MSCONFIG. The only time we could tell that *Spector* was there was when we fired up *Unreal Tournament*—it paused periodically while *Spector* snapped a picture of our actions.

Of course, that could throw a real wrench in your spying scheme, as could the fact that *Spector* doesn't capture DOS sessions. Its keystroke logs are also incredibly difficult to read, since they're displayed in a teeny window with excessive text wrapping.

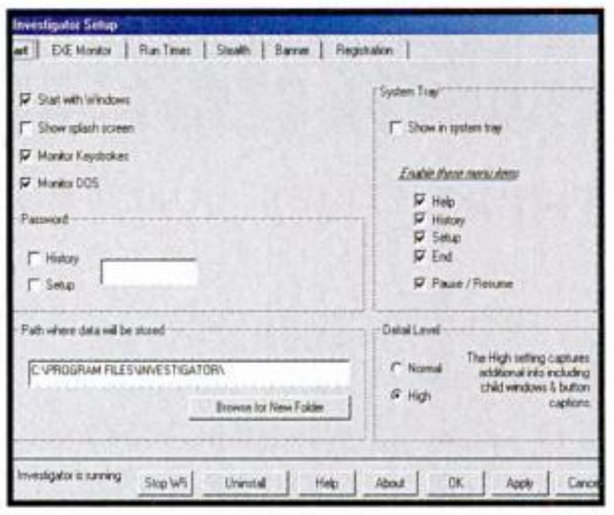
Since installation and retrieval of images using *Spector* actually requires you to sit for short periods of time at the PC you're monitoring, this program is really aimed at people who want to know what their kids or roommates are doing at the computer when no one else is around. In spite of this, *Spector*'s insidious design makes it one scary application that we can't help but recommend.

Investigator 2.0

If *IKS* is MI5 (the British intelligence agency), *Investigator 2.0* is the NSA—big, bad, and chock full of features. It's the kitchen sink of security programs, and the only program here that can be deployed through e-mail to a target PC. It's able to capture keystrokes in detail, monitor applications being used, and even log the user name and IP address of the ensnared PC. *Investigator* also snags the caption name of the top-level window. One downside to the program is the massive amount of information it generates, but an included tool sorts the data into neat, spreadsheet-like columns that are easily queried.

Investigator's most sinister feature is its ability to transmit to anyone, via e-mail, the information it captures. Simply load the software onto a machine, enter SMTP information and a valid e-mail account, and the client will begin to send information back to you. *Investigator* doesn't stop there, though. As we mentioned before, the program also has a deployment module that you can send as an e-mail attachment. You're given the freedom to name the client anything—such as FreePorn.exe—so you can trick others into opening it. Once the unwitting rube opens the attachment and executes it, the program does two things: secretly installs a stealth client that tracks user behavior, and causes the computer to spontaneously reboot, so a user will think there's been just another random crash.

Though we think the stealth e-mail client is a brilliant idea, a 3MB attachment is far too big to get past most people without them noticing something out of the ordinary.



***Investigator* gives you extensive options for your data collection needs.**

During interoffice testing, we named the client NV15INFO.EXE and e-mailed it to our videocard guru, Sean Downey. He didn't take the bait. Another unwitting tester was alerted to our monitoring by the firewall on his PC. Turns out the PC was equipped with the anti-hack tool Black Ice Defender (available from **www.networkice.com**), and it spotted the logs as *Investigator* was secretly mailing them out.

Of the three apps we checked out, *Investigator* is the most difficult to configure. We also would have liked the option to grab screenshots. However, for a program that costs only $99, *Investigator* has more features than the law should allow.

—Gordon Mah Ung

INVISIBLE KEYLOGGER 8
$80 | Amecisco
www.keylogger.com
www.readershop.com
877.751.7467 | ID#0513

SPECTOR 9
$100 | Spectorsoft
www.spectorsoft.com
www.readershop.com
877.751.7467 | ID#0514

INVESTIGATOR 2.0 9
$100 | Winwhatwhere
www.winwhatwhere.com,
www.readershop.com
877.751.7467 | ID#0515

IS ANY OF THIS LEGAL?

There are two questions you should ask yourself before you embark on your mission.

- Is the use of spying software legal? Well, that's a grey area. The software doesn't appear to violate any existing federal laws on privacy. While employers cannot secretly tape employees' phone conversations without notifying both parties, they can rummage through your desk, your purse, or your PC without your consent. There's even less legislation governing the use of such software by parents or individuals who install it on their PCs at home. This may all change as new laws are passed to protect privacy at work and possibly even on home PCs.
- Is it ethical to use any of these applications? Sorry, we can't help you with this one, but we urge you to consider how you would feel if someone was monitoring your computer habits. Or, maybe they already are…

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Aberdeen Loch Ness D80G

THERE'S NO MYSTERY HERE—THIS ONE'S A BEAST

Aberdeen's Loch Ness machine is a tower of power.

If you're one of those back-seat PC critics who moaned about the perfect 10 we gave the Dell XPS B800R in our March issue, Aberdeen may have exactly what you're looking for.

The Loch Ness D80G addresses some readers' concerns with the Dell's 200-watt power supply and limited PCI expansion capabilities, while offering similar performance. Despite certain similarities, these machines differ significantly. Think of the Aberdeen as the Dell's evil twin.

Dell's machine uses an Intel 820-based motherboard and expensive Direct RDRAM, or Rambus, memory. The Aberdeen uses a Tyan Trinity 400 mainboard with support for VC133 and PC133 memory. Argue all you like about which is faster, but keep in mind that RDRAM costs mucho dinero, and Aberdeen was able to pack 256MB of memory into its box, thanks to the cheaper price of PC133 SDRAM. And Aberdeen's Tyan board allows you to use both Socket 370 and Slot 1 CPUs.

Although both boxes sport Coppermine 800MHz Pentium IIIs, the Dell displayed a clear advantage in several benchmarks. It beat the Aberdeen like a red-headed stepchild in *bootMark*, posting a score of 423 to the Aberdeen's 348. The Dell also slapped the Aberdeen around in *3DMark 2000* with a score of 4,782; the Aberdeen managed a score of 4,552.

Of course, these are just synthetic benchmarks. In real-world tests, the Aberdeen's scores were just a tick away from the Dell's in the tests that really matter: *SYSMark 2000*, *Quake III*, and the Direct3D test in *3DMark 2000*. Remember the RAM amount advantage we mentioned? It paid off in *Photoshop*, where the Aberdeen eclipsed the Dell's already impressive score. That "would not run" you see in the MP3 ripping/encoding benchmark box is the result of the Aberdeen's refusal to run *MusicMatch Jukebox*; opening the program resulted in constant error messages.

If you want drive bays and expandability, the Aberdeen has more to spare than most PCs have altogether. In the same Addtronics case we chose for our Dream Machine 98, the Loch Ness is taller than the average third-grader. Even with the 10x AOpen DVD-ROM, Plextor 8/4/32 IDE CD-RW, and Sound Blaster Live! drives installed, the Loch Ness can take four additional full-size drives.

Interestingly, Aberdeen chose to configure the Loch Ness with an LS-120 drive. It's a nice alternative to a plain-Jane floppy drive, but we wonder if anyone still uses these dinosaurs. Aberdeen also compromised in the sound and multimedia departments; the mediocre Cambridge Soundworks DTT2500 speakers and the *XingSoft DVD* offer average image and sound quality, at best.

If the Loch Ness had hit our benches last December, we would have been bowled over like a gnat in a twister, but in the days of 866MHz Pentium IIIs, 1GHz Athlons, and 64MB GeForce cards, Nessie's configuration is just about average. Still, for the money, the Aberdeen is a solid rig for not-too-much scratch.

—Gordon Mah Ung

PLUSES
- Big-ass case
- Quarter Gig of RAM
- Many, many fans
- Aperture grille monitor

MINUSES
- Cambridge Soundworks speakers
- SoftDVD

UNDER THE HOOD

THE BRAINS	
CPU	800MHz Intel Pentium III
L2 Cache	256KB full speed
RAM	256MB PC133 SDRAM (Max 768MB)
Motherboard	Tyan Trinity 400 on VIA Apollo Pro 133A
Drive Bays	Seven 5.25-inch bays, one 3.5-inch bay
I/O ports	Two USB, one parallel, one serial, IEEE 1394
DISPLAY	
Video	Guillemot 3D Prophet GeForce, 32MB DDR SDRAM
Monitor	Viewsonic PF790 19-inch (18-inch viewable, 0.25 to 0.27 grille pitch)
Refresh@ Max Res	75Hz@1600x1280
STORAGE	
Hard Drive	28GB Seagate Barracuda ATA/66, 7200rpm
DVD	AOpen DVD-104O 10x
CD-RW	Plextor 8x/4x/32x IDE
SOUND	
Soundcard	Sound Blaster Live! Platinum
Speakers	Cambridge Soundworks DTT2500
NETWORKING	
Realtek Faster Ethernet NIC, US Robotics Voice modem	
THE BUNDLE	
Windows 98 second edition, XingDVD player, Plextor Manager	

BOOT 0:50 DOWN 0:03

BENCHMARKING

REAL WORLD

CPU/MOTHERBOARD bootMark		348.4
WIN9X APPS SYSmark 2000	official score	157
HARD DRIVE HD Tach	MB/sec	21.5
CD-ROM CD Tach98	drive rating	24.8x
MP3 RIP/ENCODE MusicMatch	sec	Would Not Run
IMAGE EDITING Adobe Photoshop 5.5	sec	160.5
DIRECT 3D 3DMark 2000	fps	53.4
OPENGL Quake III Arena	fps	48.5

0

See page 68 for benchmark explanations.

MAXIMUM PC VERDICT 8

$3,400 ($3,000 without monitor)
Aberdeen | www.aberdeeninc.com
www.readershop.com
877.751.7467 | ID#0516

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EXPANSION NOTES

There's enough room in the Loch Ness case to move in an entire shelf from CompUSA *and* the Brady family—even Alice.

EXPANSION MAP

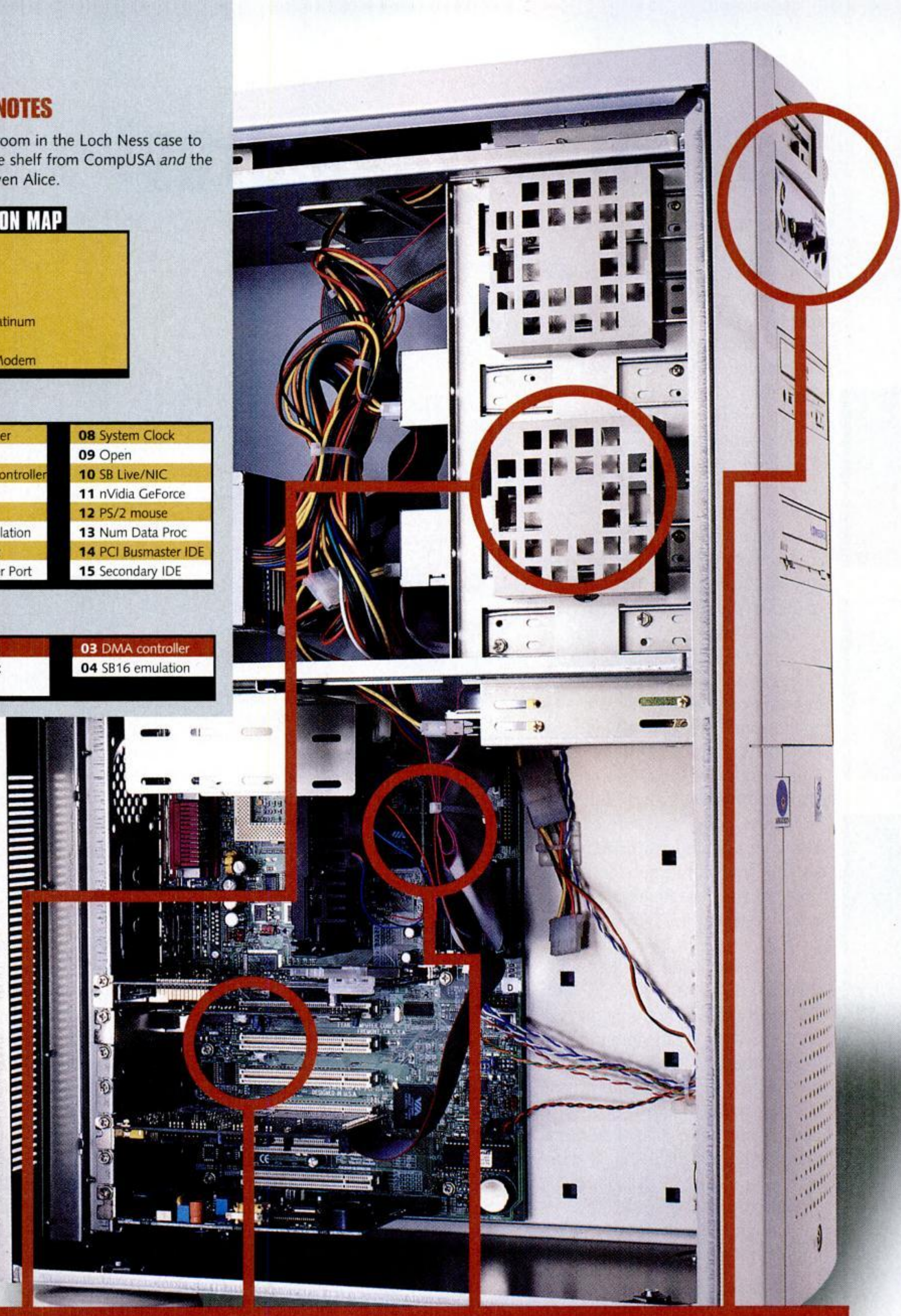
- **AGP** GeForce
- **PCI** NIC
- **PCI** Open
- **PCI** Open
- **PCI** SB Live! Platinum
- **PCI** Open
- **PCI/ISA** 56K Modem

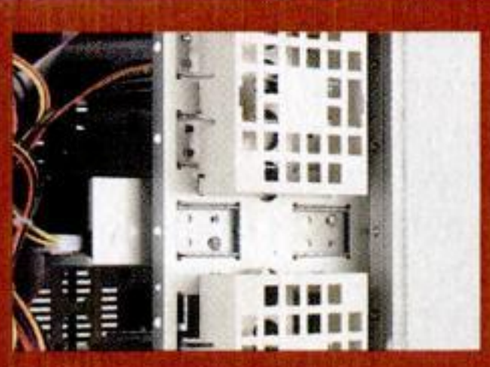
IROS

00 System Timer	**08** System Clock
01 Keyboard	**09** Open
02 Interrupt Controller	**10** SB Live/NIC
03 Com 2	**11** nVidia GeForce
04 Com 1	**12** PS/2 mouse
05 Sound Emulation	**13** Num Data Proc
06 Floppy Port	**14** PCI Busmaster IDE
07 LPT1 Printer Port	**15** Secondary IDE

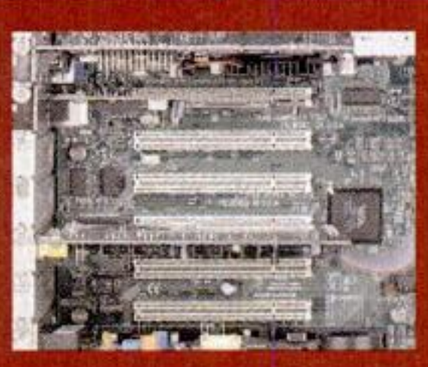
DMAS

01 Soundcard	**03** DMA controller
02 Floppy disk controller	**04** SB16 emulation





Fans galore If the Loch Ness was in a James Bond movie, its name would be Blow Me Galore. With room for a gazillion fans (well, almost) the Loch Ness practically needs FAA approval for take off.



Got PCI Cards? We'd shove in a hardware DVD decoder, U2W SCSI card, a Voodoo2 and... and...drat! We're out of upgrades!

VIA to the rescue VIA's chipset saves you from purchasing Direct RDRAM memory.

Does anybody have one of these? You'd have to travel far and wide to find another person with an LS-120 drive.

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Optical storage orgy!

THREE DRIVES FIGHT TO BE YOUR ONE AND ONLY

Everyone could use an optical drive, but deciding which drive to buy can be tricky. To sort things out, we've assembled a "who's who" of the optical world. We'll check out a drive that combines DVD-ROM capabilities with a CD-RW, effectively creating a movie-ready CD burner. We'll also look at a 72x CD-ROM drive from Kenwood, the first post-lawsuit drive from Kenwood using the much-maligned TrueX technology. (Concerning the TrueX issue, we'd prefer to not "go there," as they say on Springer. But rest assured, we tested the bejeezus out of this sucker before deciding on a verdict.) And we'll spend some time with an old favorite: the 10x DVD-ROM. Sure, Pioneer released an awesome 10x DVD-ROM a while back, but now AOpen has one, too. Before you dismiss it as a copycat drive, we'll let you in on a little secret: It's speedier than the Pioneer 10x drive we tested last November.

RICOH
PLUSES
Quick DAE
MINUSES
Major CD-RW problems
Pricey

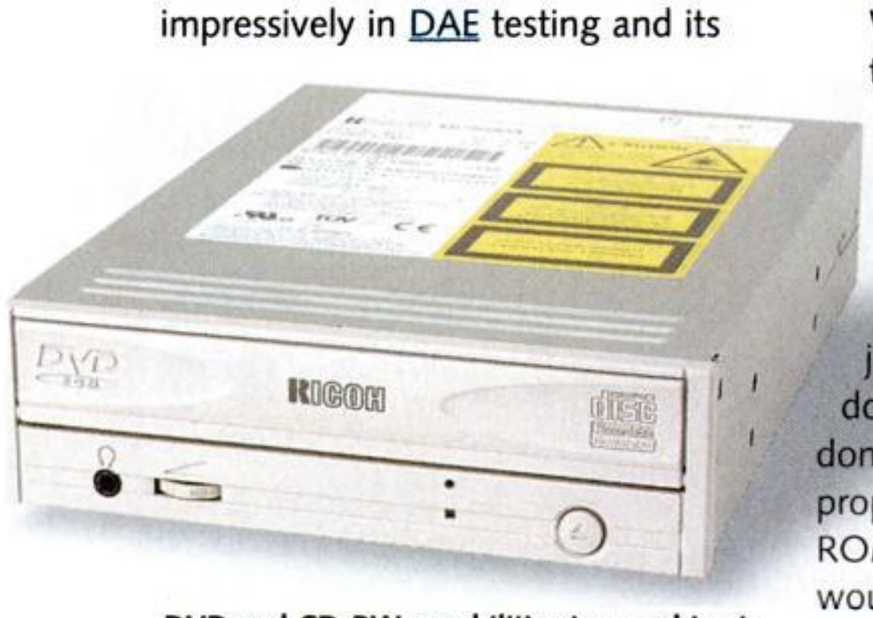
KENWOOD
PLUSES
Fast
Really, really fast
MINUSES
Reliability concerns

AOPEN
PLUSES
Fastest DVD-ROM
MINUSES
No MPEG card included

Ricoh MediaMaster MP9060A 4x DVD, 6/4/24 CD-RW

The MediaMaster not only plays DVD-ROMs in crisp, vibrant color, it also produces dozens of coasters on which you can rest your favorite beverages. That's right—*dozens*. This drive produced so many bad burns, we rung up a media bill rivaled only by the bar tab at the *Maximum PC* Christmas party.

Though the MediaMaster scored impressively in DAE testing and its DVD-ROM capabilities work as promised, we simply could not get this drive to reliably record CDs—not even once. We moved it to different IDE channels, changed master/slave relationships, and tried third-party burning software, all to no avail. We even gave Ricoh two chances to get it right. When the first unit we received starting eating media like Homer Simpson eats donuts, we called Ricoh and suggested that we'd been sent a lemon. Ricoh said it was a "pre-production unit" (even though it arrived in a retail box), and sent us another. The replacement drive fared a tad better than its predecessor in terms of CD duplication, but ultimately, the second performed as unreliably as the first. Bollocks!



DVD and CD-RW capabilities in one drive is a tantalizing idea, but Ricoh hasn't yet worked out all the bugs. The unit we tested refused to burn CDs reliably.

We admit that we really wanted to have our cake and eat it, too. We wanted to see a drive that posted good scores for both DVD and CD-RW performance. Maybe the MediaMaster has the first-generation-technology jitters, or maybe it's attempting to do something that can't actually be done. But even if it had performed properly, the MediaMaster's 4x DVD-ROM and 6/4/24 CD-RW speeds wouldn't have cut the mustard.

A Ricoh engineer said the MediaMaster's inability to record CD-Rs is a "known problem," but that in the latest batch of drives he'd seen, only one was bunk. Say what? One bad drive is one too many in our opinion. Our advice is to stay away from this puppy, because from what we saw, it simply doesn't work.

Kenwood's TrueX drives use a 7-beam pickup that reads in parallel, allowing the drive to hit a phenomenal 61x drive rating.

Kenwood 72X TrueX

The 72X drive uses TrueX technology, which combines a slow-spinning motor with a 7-beam Pickup, allowing parallel reads at a high rate of accuracy. While most drives spin at speeds of up to 10,000rpm and deliver read speeds as high as 48x, a TrueX drive's employs seven lasers, allowing it to spin at speeds between 2700 and 5100rpm but still read more data than other drives.

In testing, the 72X performs amazingly well. Its *CDTach* drive rating is a phenomenal 52.6x—more than twice as fast as any other drive we've seen. The 72X also posted the fastest MP3 ripping and encoding scores we've seen. Granted, our ripping/encoding benchmark was recently implemented, so we haven't yet tested it on a litany of drives, but the 72X did outscore both 10x DVD-ROM drives currently in The Lab, and outperformed the famous TDK veloCD in audio-extraction testing.

Few people will deny that the TrueX drives are fast, but given the technology's checkered past, reliability is the real concern. To that end,

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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we performed three tests designed to push the limits of the 72X's capabilities. First, we ripped and encoded a CD containing 348MB of Redbook audio 10 times in a row at a rate of 320kbps, with error correction enabled for increased accuracy. Amazingly, the drive ripped successfully at about 9x—the speed at which most drives encode at lower bitrates without error correction.

Second, we ran *CDTach* in a loop, using a VXD file to test just the CD-ROM's performance by forcing it to read from nine random disc locations. Even after the sustained punishment of 100 back-to-back *CDTach* attacks, the 72X came through with flying colors.

Finally, we tested how well the 72X could read a CD-R that had been burned at 8x, since earlier TrueX drives were known to be finicky about recognizing 8x golds. At first, our test drive wouldn't read any discs that had been burned at 8x, and we fancied ourselves pretty clever to have caught Kenwood up to its old tricks. But just as we were about to celebrate the newly discovered scandal, we learned of a firmware update that solves the problem. Begrudgingly, we fired up our browser, downloaded and installed the firmware, and found that it worked just fine. Curses! Foiled again!

In the end, we were forced to admit that the 72X seems to work as it should. In fact, it's significantly faster than any other drive we've seen. Kenwood has obviously taken a lot of flack—and is dealing with some serious legal problems—due to the unstable nature of the 52x and 42x drives, so we're assuming the company made a point of working out the bugs in the 72X. We're prepared to declare it safe to buy TrueX again, but we're withholding the Kick Ass award, since it burned us last time.

AOpen's firmware bumps this drive's speed past that of the Pioneer 10x drive we tested in November.

AOpen 10x DVD-ROM

Everyone knows that Pioneer's 10x DVD-114 is the fastest DVD-ROM drive on the market, but you may not know that AOpen also sells a version of the drive. The only major difference between the two is the firmware provided by the respective manufacturers, which our testing showed to be a small but significant difference. Like Pioneer, AOpen sells both slot models and tray models. We tested a slot model, which AOpen calls the "Pro." We assume this is AOpen's tip of the cap to professional DVD-ROM users everywhere. (Um, that was a joke.)

Odd naming convention aside, AOpen's Pro did prove slightly faster than the Pioneer unit we tested in November. As you can see from the benchmarks, the AOpen drive improved modestly on the Pioneer's scores; its drive rating is a tad higher, as are its sequential read scores. We're chalking the improvement up to AOpen's firmware, since Pioneer told us that it's the only real difference you'll see between a drive sold directly from Pioneer and one sold from a vendor such as AOpen.

So why would you want to buy AOpen's drive instead of Pioneer's? It all comes down to movies. Pioneer sells its drive primarily as a DVD-ROM kit, and bundles it with the RealMagic Hollywood Plus MPEG decoder card. If you don't often watch movies on your PC, the AOpen drive's slight speed advantage makes it the better choice.

Though faster is better, we feel we should add that we weren't actually all that impressed with the speed of this drive. When the 10x first appeared last November, no other vendor was offering a 10x drive. That made the Pioneer DVD-114 a shoe-in for a Gear of the Year award—last year. This year, our hopes for reaching optical ecstasy are pinned on Pioneer's upcoming 16x DVD-ROM.

—Josh Norem

RICOH MEDIAMASTER — 2

$400 | Ricoh
www.ricoh-usa.com
www.readershop.com
877.751.7467 ID#0517

KENWOOD 72X TRUEX — 9

$130 | Kenwood
www.kenwood.com
www.readershop.com
877.751.7467 ID#0518

AOPEN 1040 PRO — 9

$140 | AOpen
www.aopen.com
www.readershop.com
877.751.7467 | ID#0519

DARE TO COMPARE

MANUFACTURER	KENWOOD 72X	RICOH COMBO	AOPEN 10X	PIONEER 10X*
CD Tach Drive rating	**61.6x**	16.1x	26.7x	23.7x
Max. sequential read speed (MB/sec)	**10.01**	3.57	5.91	5.3
Min. sequential read speed (MB/sec)	**6.71**	1.58	2.61	2.3
CPU utilization (max/min)	**15% | 5%**	34% | 8%	33% | 4%	28% | 7%
Random seek time (in milliseconds)	115	110	**76**	78
Full-stroke access time (in milliseconds)	277	202	**135**	157
Time to rip/encode 348MB CD to MP3 (in seconds)	**197**	205	241	237

Best scores are bolded. * The Pioneer drive was reviewed in November 1999. Its benchmark scores are reproduced here for reference purposes.

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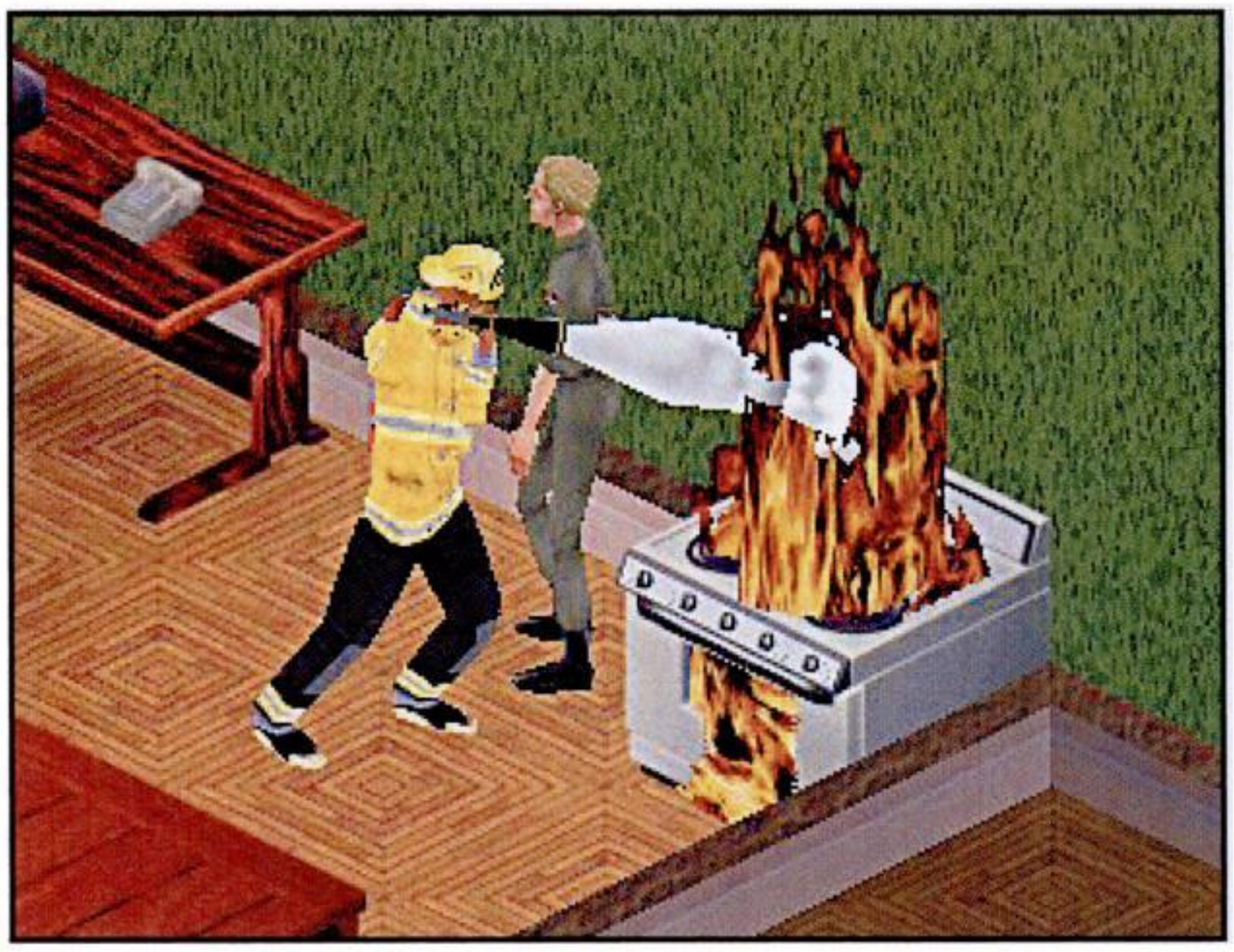
The Sims

NURTURE YOUR GOD COMPLEX



Anything can happen to the people you control in *The Sims*—a fascinating experiment of fate vs. free will.

MAXIMUM PC KICK-ASS! product

By now you've probably heard of *The Sims*, the "real life" simulator that lets you create and control simulated people on your PC. We've been suffering from delusions of grandeur for a long time, so we couldn't wait to get our hands on the game and begin lording over our Sims like giant monsters reigning over a Lilliputian village.

THE SPECS

3D CARD SUPPORT
None

3D SOUND SUPPORT
DirectSound

MULTIPLAYER
None

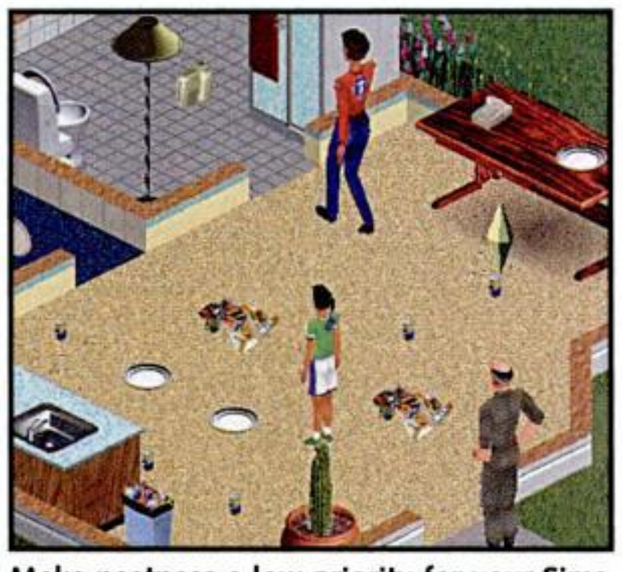
We created the people in our Sim family in the images of *Maximum PC* staff members, doling out characteristics such as neatness, playfulness, and energy among the six characters.

PLUSES
- Brilliant design
- Clever interaction model
- Endless customization
- Addicting

MINUSES
- Sims don't get weekends off
- No pets
- Addicting

From the start, our Sim staff was in trouble, with Sim Editor-in-Chief Jon Phillips leading the way. With blatant disregard for health and hygiene, Mini Philly constantly threw his trash on the floor. News Editor Gordon Mah Ung's Sim spent all his time in front of the radio, dancing indiscriminately with both men and women. Features Editor Sean Downey's Sim did nothing but watch TV and sleep. Managing Editor Kristen Salvatore's Sim was the only one who got a job and went to work, leaving the males at home to tinker with PCs all day.

We set the game in Free Will mode for a while and let our staff Sims handle their own affairs. When we returned to the computer, there were five tombstones in the front yard of our Sim house. Not a good sign. We discovered that Kristen was the only remaining Sim, but she was an emotional wreck, since all of her friends had died. Burying them in the front yard probably hadn't helped this situation, but that's Sim logic for you. When the Sims are left to their own devices, the results are usually disastrous, so you have to help them by controlling their interactions with their environment, and helping them fulfill their needs based on a bar chart display that moves up or down as needs are satisfied or ignored. For instance, if a male Sim's bladder rating is in the red zone, you know he has to take a leak, so you direct him to the toilet and select "use." After he does his business, his bladder rating goes up because that need has been fulfilled. If you don't help him, he's likely to make a puddle on the floor, and the resulting embarrassment will cause his emotional well-being rating to drop. They're complex little creatures, these Sims.



Make neatness a low priority for your Sims and they'll live like slobs.

Technologically, *The Sims* is a half-breed, combining 3D polygonal models with 2D, sprite-based backgrounds. The Sims themselves are comprised of about 1,000 polygons each, with an amazing level of detail. The 100 or so objects you can buy in order to satisfy your Sims' needs (TV, refrigerator, toilet, bed, pool table, etc.) are sprite-based, and contain complex coding. The Sims themselves simply walk around and satisfy their personal needs; it's the 2D objects in the game that contain all the coding. When a Sim "activates" a radio, for example, he's actually executing a script that will alter his happiness and fun ratings. The same happens to all the other Sims present, but the results are different according to the situation. When the Sim turns on the radio, another Sim might begin to dance, a third might become angry because she's trying to sleep in the next room, and so on.

Eventually, you stop playing *The Sims*; they play you. It's easily the most addictive game we've played in some time, and it gets our vote for the most original game of the year (so far). We also vote for Jon Phillips as the messiest Sim of the year.

— Josh Norem

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Sirocco Spirit

WHAT ABOUT THE SUBWOOFERS?

You got sub in my sats! Hey, you got sats in my sub! Hmmm, the Sirocco Spirits are two great speakers that sound towering together.

When this Videologic two-piece system came in for review, we all laughed long and hard at the sub-less black towers. But then we turned them on and holy cow! We were impressed.

Despite its simplicity, the Sirocco Spirit is one of the best-sounding speaker systems we've heard in a while. Rated at a total of 50 watts, these speakers can get loud. Really loud. Four separate amps and a toroidal transformer kept near-field performance distortion-free—even during our most grueling game and music tests. In fact, decibel-for-decibel, the Spirit system easily rocks as hard as Klipsh's vaunted ProMedia V.2-400.

The 12-inch tall speakers combine a shielded four-inch Audax sub cone and a 10mm polymer dome in a heavy-duty casing, allowing for seamless crossover that's not possible in satellite systems. Unfortunately, the system's "Dynamic Virtual Sub Technology" doesn't deliver the response of a dedicated sub. In frequency-response testing, the low-end response cut out far sooner than systems with subwoofers. There is a sub-out jack, but matching the unique signature of such a setup was challenging.

A second jack on the back of the speakers allows you to connect a second source. Although this sounds odd at first, it does allow you to get crafty by hooking up a pair of turntables (or minidisc players, or CD players, or whatever) to put on a serious display of your DJ abilities. Despite this feature, the effect pretty much blows.

Another awkward aspect is the sheer size of the Spirit speakers. If you're accustomed to baseball-sized sats or sexy flat speakers, brace yourself for a pair of speakers the size of shoe boxes flanking your monitor.

Combining considerable power with controlled response, the Sirocco Spirit will surprise anyone with a prejudice against systems lacking a dedicated subwoofer.

—Brad Dosland

PLUSES
- Seamless crossover
- Loud
- Sub-out jack
- Raise-the-roof dual inputs

MINUSES
- Weak sub response
- Big boxes
- No rear sats for positional audio

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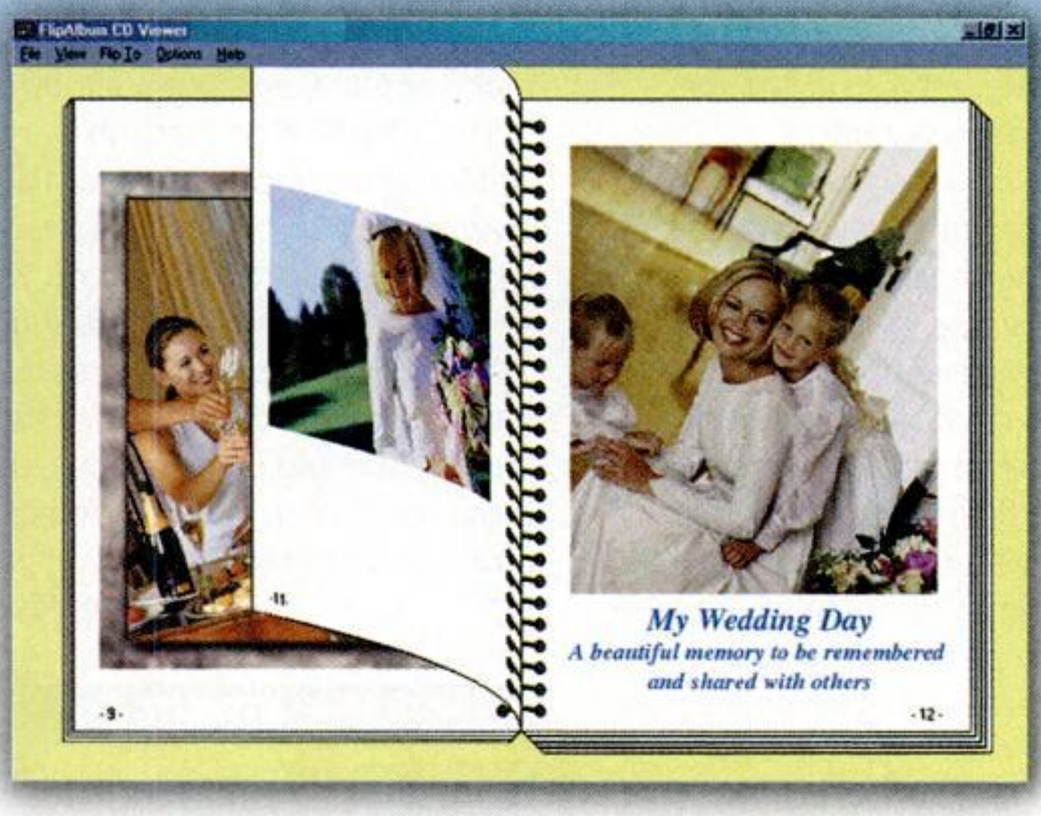

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Samsung SyncMaster 170MP

PRETTY, PRETTY PIXELS WITH A TV TUNER CHASER

With a $2,600 price tag and a wow factor that leaps off the charts, the SyncMaster 170MP is the kind of wildly decadent tech toy that Tony Soprano might leave on your doorstep as a "thank you warning" (not to be confused with a "thank you gift," which usually takes the form of a pan of baked ziti). If *your* local crime boss ever drops off the 170MP at the foot of your azalea bushes, resist all impulses to send the flat-panel back. Take it inside and enjoy the luxury, because some things in life are worth living dangerously for.

PLUSES
- Built-in TV tuner with remote control
- Picture-in-Picture
- No video noise
- Good grayscale repro

MINUSES
- Slow pixel response
- Two adjacent stuck pixels
- Cannot resolve 24-bit color

THE SPECS

DISPLAY SIZE
17-inches diagonal

NATURAL RES
1280x1024

WEIGHT
14.3 lbs

DIMENSIONS
17.6x17.2x8.15 inches (WxHxD)

VIDEO INPUTS
15-pin VGA, S-Video, composite video, cable/antenna

The 170MP is a 17-inch, TFT display with a built-in TV tuner. That's right, baby: This bad boy plays for both teams. Once fully jacked in, you can alternate between working on your computer and watching up to three video sources. And if you absolutely must keep your PC desktop dominant, you can watch your video source in a picture-in-picture window. The PIP window comes in two default sizes, and can be placed anywhere onscreen. Unfortunately, your PC desktop can't be a PIP window within the full-screen video display.

As a cable TV monitor, the 170MP performed much better than expected, but couldn't overcome some intrinsic flaws of TFT technology. We placed it beside a Sony Trinitron TV to look for image disparities, and were happy to discover that the 170MP looked only a tad washed-out in comparison. Black levels were slightly lighter than the Sony's level, colors were slightly less vibrant, and fine text appeared just a bit blurrier. Nonetheless, we were impressed! LCDs have come a long way in the past 18 months.

As luck would have it, the State Farms Women's Tennis Classic was airing during our cable testing, and we were able to catch the semi-final match between Lindsey Davenport (Boo!) and Anna Kournikova (Yeah!). What a perfect opportunity to look for flaws resulting from slow pixel response. Specifically, we wanted to see if the tennis balls exhibited streaking during fast serves and volleys. LCD monitors are notorious for being incapable of tracking fast-moving action in games and video; the pixels simply can't keep pace.

The 170MP's display is so clean, we thought it was running a digital interface.

Just as we feared, the balls looked like comets as they streaked hither and yon. Lesson number one: Even this most superb of LCDs hasn't beaten the slow-pixel-response bugaboo. Lesson number two: Anna Kournikova is too hot, hot, hot for the WTA! Might we suggest a spokesmodel role on "Sabado Gigante?"

As a PC monitor, the 170MP breezed through the *DisplayMate* obstacle course. Samsung has greatly improved its pixel tracking and locking since we reviewed its SyncMaster 520 model, and once we adjusted the 170MP's fine-image-lock control just a smidgen, the display looked remarkably crisp, with razor-sharp text legibility. We almost thought we were looking at a pure digital interface (analog interfaces can introduce shimmery video noise in LCD panels). Grayscale reproduction has also improved: *DisplayMate*'s graduated blends showed no nasty banding. Very light grays were distinguishable against a field of pure white, but performance dropped off a tad on the other end, as very dark grays were lost in a field of pure black.

Like all TFT panels we've reviewed (save the SGI 1600SW), the 170MP cannot resolve the full 24-bit color range—24-bit test images were dithered, but not horribly so. Still, you wouldn't want to use this panel for professional image editing. The panel we reviewed also came with two stuck pixels, which shouldn't be enough to give anyone agita, but the two bum pixels were adjacent to one another, which is a big no-no.

The 170MP is an irresistible extravagance despite its minor flaws. No workaday tech geek really *needs* one, but that has nothing to do with why it should be sitting on your desk. Get one of these babies and start living the good life. Just don't return it to Mr. Soprano unless you're willing to change your name and relocate to a small town in Maine.

—Jon Phillips

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Manage your Money, Honey

INTUIT VS. MICROSOFT: FIGHT!

Managing money can be tough, especially when you're a journalist. Take our word for it—it's hard to keep track of checks for thirty-five cents. But when times get tough and we need financial assistance, we turn to our PCs, where two perennial competitors vie for the honor of managing our dough: Intuit's *Quicken* and Microsoft's *Money*. Both apps assist you with managing your finances; banking online; writing checks; planning for tax time; and watching your Internet stocks take roller coaster rides in realtime. While the two are substantially more similar than they are different, the areas in which they diverge are significant enough to sway an experienced user.

MONEY 2000

PLUSES
- Seamless web integration
- Retirement planning

MINUSES
- Lackluster check writing system
- Wizard...must... die

QUICKEN 2000

PLUSES
- Superior check writing system
- Integration with TurboTax

MINUSES
- Limited web links
- Lack of online content
- Only slightly improved

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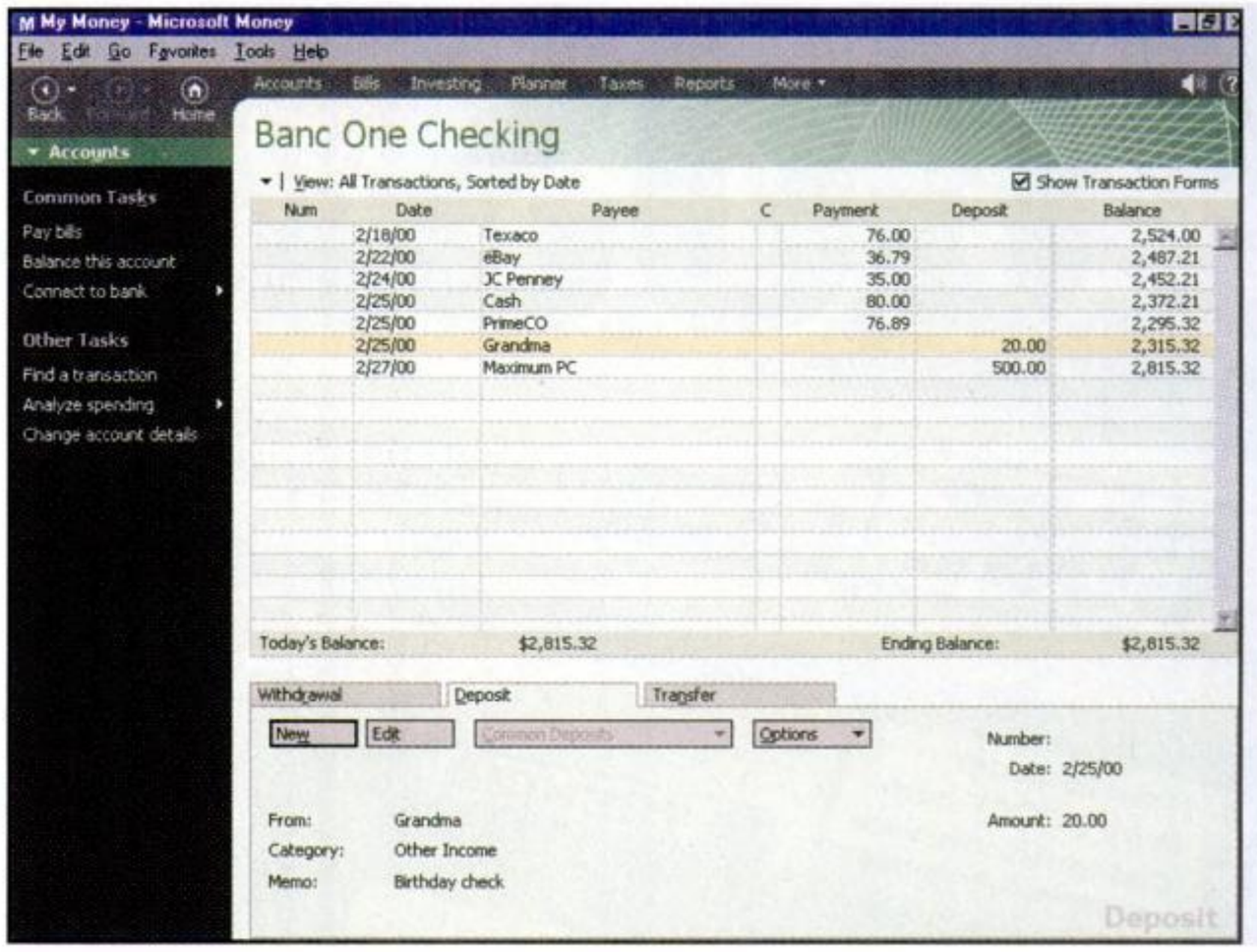


Money's **check register is easy to use, but you have to input check information into an awkward form.**

Microsoft Money 2000

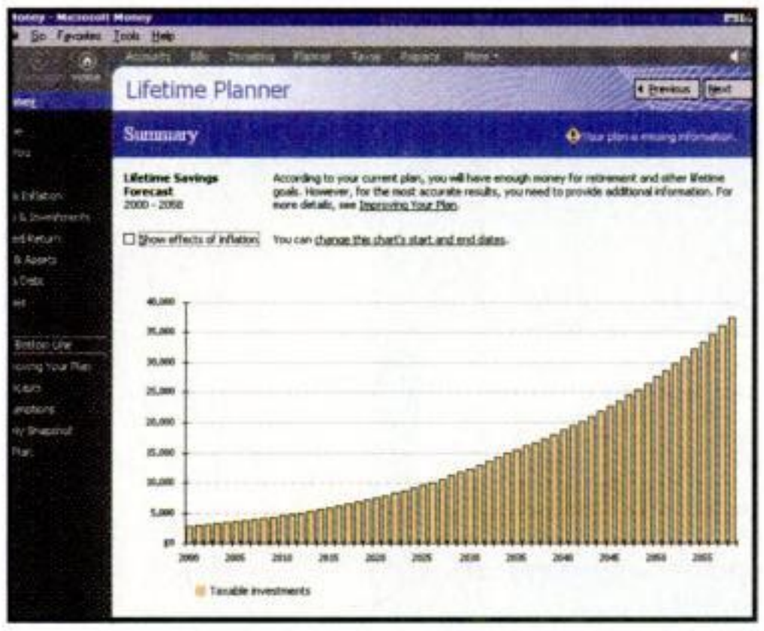
Money has long been a close second to Intuit's *Quicken*, but Microsoft is clearly looking to change that with the latest rev. The folks in Redmond have added a host of improvements to their flagship financial program, and are finally delivering a product that stands on its own merits instead of trying to pass as a *Quicken* body double.

The most appreciated enhancements include better investment features, increased web integration, and extremely useful planning modules. *Money* has always offered strong investment tools, and its new features can handle stock splits and corporate mergers, along with tracking bonds and CDs—a useful feature amid the present merger mania. *Money* isn't as intuitive as *Quicken* when it comes to offering investment assistance and advice, but the additions are a step in the right direction.

Where *Money* really shines is in life event planning; it offers a horde of different plans for achieving such goals as saving for college and building a plush retirement fund. The *Money* lifetime planner is easier to use than *Quicken*'s planner, and can encompass your entire financial universe, from birth to death, into a single plan. Income events, such as changing jobs...or selling an RDRAM RIMM (cue rimshot), are easy to enter, and integrate smoothly into the plan. *Money* even lets you evaluate life insurance policies to determine the long-term benefits of various plans. A purchase wizard has also been added, offering strategies for buying big-ticket items (like an RDRAM RIMM) by figuring your monthly payments. For those who already possess some modicum of financial common sense, the planning programs offer excellent strategies and tactics for achieving long-term financial stability.

Money's web integration is also excellent; we think it's the best found in any financial package currently available. Integration is literally seamless—at times, we couldn't tell whether we were on the Web, in the program, or somewhere in the middle. It's not as confusing as it sounds, just a bit more "integrated" than we're used to. One thing we were used to, however, were the silly Microsoft wizards popping up every 10 seconds asking us what we were up to. "I'm writing a check, damnit! Now bugger off!" Once you get past these annoying guys, the interface is uncluttered and well-designed. Common tasks and information are grouped together around such topics as taxes, financial planning, and investing.

However, most people will spend more time tracking their bill payments than investing in new silicon fabs, and it's here that we find the biggest flaw in *Money*. Its check-writing system just plain sucks, requiring you to fill out a job application-like form that looks nothing like a check. A minor point of redemption is *Money*'s auto-categorization tool, which draws upon a database of more than 500,000 companies to automat-



Money **can forecast your entire life's income, and tell you whether you'll be screwed at retirement.**

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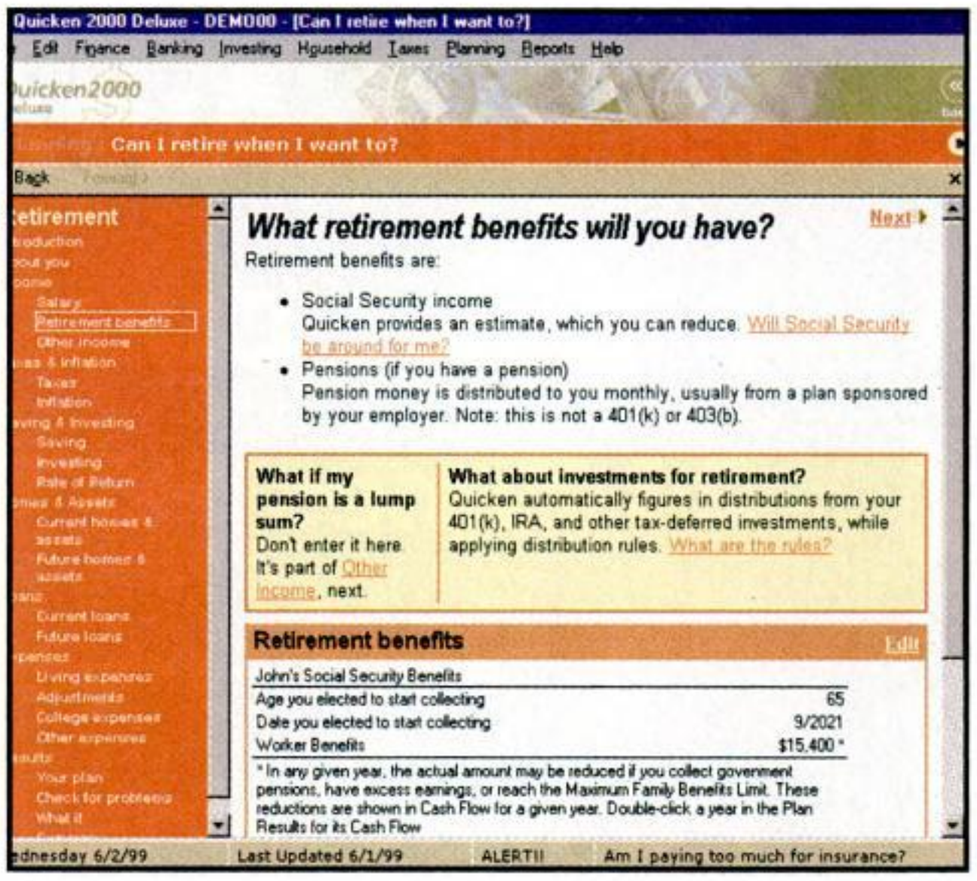
ically categorize your bill, e.g., utility, credit card or car payment, or rent. The sucker is pretty accurate, which of course led us to have some Microsoft Gestapo-like pangs, but it's handy nonetheless.

As much as we love to bash M$, the truth is that *Money* is a solid program with useful features. Its planning modules are well-thought-out, and its web interface is the best we've seen. Its wizards are lame, and its check writing system could learn a thing or two from *Quicken*, but in our opinion, Microsoft has just pulled ahead of *Quicken* in this race.

Intuit Quicken 2000 Deluxe

The latest revision of *Quicken* offers only minor changes from the previous version, which is disappointing in light of all the new features displayed in Microsoft's offering. While we'll admit that *Quicken* was working pretty well to begin with, there's still some room for improvement. Most of the changes to the 2000 version are intended to improve the package's investment offerings, but with Microsoft making leaps and bounds in *Money*, *Quicken*'s age is starting to show.

Quicken's investment center has always been the app's prize cow. It now includes investment alerts that notify you of hot stocks and other investment opportunities. A new utility charts multiple securities alongside market indicators, graphically displaying an investment's performance over time. Other notable additions include planning modules that were previously only available in Intuit's *Quicken's Financial* Suite. Like *Money*'s planning tools, they enable you to plan for big expenditures such as college, or a Voodoo 5 6000. Though we welcome the addition of previously unavailable planning tools, Microsoft's offering lays the financial smack down on Intuit in this area. Quicken's features just aren't as all-encompassing as *Money*'s, and they don't provide enough assistance with developing strategies for long-term investments.



***Quicken's* retirement planning section is a tad busy, but offers solid advice on how to plan ahead for the golden years.**

However, *Quicken* does get the nod when it comes to tax planning, largely due to its integration with Intuit's blockbuster tax preparation program *TurboTax*. A new tax alert feature in *Quicken* keeps you up-to-date on capital gains, and the new itemized deduction estimator determines whether you should adjust withholdings before sending your taxes off to Uncle Sam. Microsoft recently introduced a new tax program of its own called *TaxSaver*, which promises to work with the tax-planning modules in *Money*. We've yet to experience the two programs in unison, so for this tax season, we're sticking with *Quicken*.

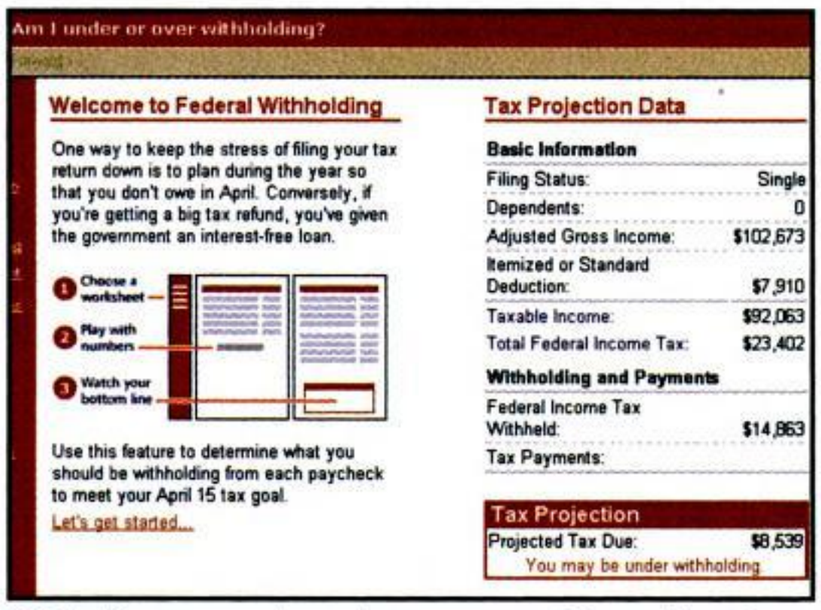
Quicken 2000 employs the same web-style interface present in the last version of the app; it's intuitive and easy-to-use. Writing checks is also a snap, since *Quicken* has the best check-writing program this side of Wall Street. Just fill out a giant virtual check, and the program does all the legwork. Copies of all the checks you've written are also kept in an easy-to-search database.

Like *Money*, *Quicken* has an online counterpart: a financial portal called **www.Quicken.com**. But integration between *Quicken* and the web site is less transparent than *Money*'s web integration, and the *Quicken* web site offers much less content than *Money*'s—hardly a surprise when you consider how vast Microsoft's resources are, compared to Intuit's. Still, you can search quicken.com for investment funds, bonds, and stocks, and a gigantic database of stock performance assists you in charting securities against one another. Other features include an online credit repair service (we like this one), property and car value listings, and investment prices.

The Final Word

Though Microsoft has been sniffing Intuit's gluteus maximus for years, it's finally taken the lead with *Money 2000*, with planning modules and web interfacing that far outpaces *Quicken*'s. If you're already a *Quicken* user and your main concern is tax planning, *Quicken*'s easy integration with *TurboTax* means there's not much reason to switch now. But if you do want to make a break for it, *Money* offers a conversion tool that painlessly imports your *Quicken* files. Switching to the Dark Side has never been easier.

—Joe DeRouen



Witholding money from the government is our favorite pastime, and *Quicken's* guide is the best we've seen.

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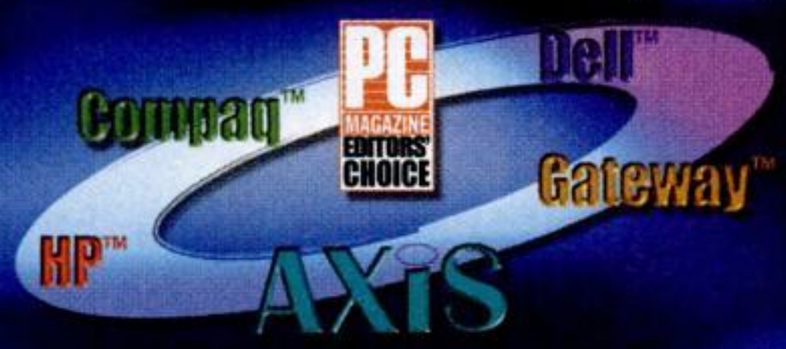

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- **10X DVD-ROM Drive**
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- **Creative Labs Sound Blaster Live! Value 3D Wavetable Sound Card**
- **Creative Labs Cambridge SoundWorks FPS1000 4-Piece Speakers w/Subwoofer**
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Pentium III Processor 600MHz $1759
Pentium III Processor 667MHz $1859
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- **13.5GB** Ultra ATA/66 Hard Drive, 7200RPM
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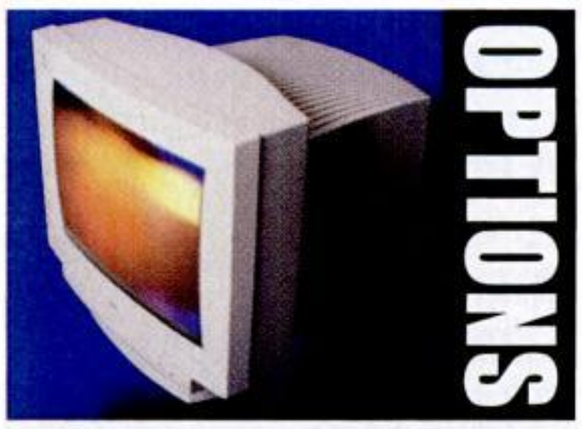

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Add a 17" (16.0vis) .26 Monitor, ***$239***
Add a 19" (18.0vis) .26 Monitor, ***$339***
Add a 15" LCD Flat Panel, ***$999***

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Add a 3Com 100Mbit Network Adapter, ***$69***
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- 1.44MB 3.5" Floppy Drive
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- 52X Max CD-ROM Drive
- Integrated ESS Solo1 PCI 3D Wavetable Audio
- Creative Labs SBS20 Speakers
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9.1GB	4MB	7,200	XC309100LW	$255
18.2GB	2MB	7,200	KN318200LW	$385
18.4GB	4MB	7,200	XC318400LW	$395
36.4GB	2MB	7,200	KN336400LW	$810
36.7GB	4MB	10,000	XC336700LW	$829

IBM

Ask about IBM's Ultra 160/m deals!

Capacity	Cache	RPM	Product No.	Price
ULTRA SCSI				
9.1GB	2MB	7,200	IBM309170N	$230
18.2GB	2MB	7,200	IBM318350N	$365
ULTRA WIDE SCSI				
9.1GB	2MB	7,200	IBM309170W	$230
18.2GB	2MB	7,200	IBM318350W	$365
ULTRA-2 SCSI				
9.1GB	2MB	7,200	IBM309170U2	$230
9.1GB	2MB	10,000	IDMVS9U2	$350
18.2GB	2MB	7,200	IBM318350U2	$365
18.2GB	2MB	10,000	IDMVS18U2	$575
36.4GB	2MB	10,000	IDMVS36U2	$945

Seagate

Ask about Seagate's Ultra 160/m deals!

Capacity	Cache	RPM	Product No.	Price
ULTRA SCSI				
9.2GB	512K	7,200	ST39216N	$290
18.4GB	512K	7,200	ST318416N	$450
ULTRA-2 SCSI				
9.1GB	1MB	7,200	ST39175LW	$265
9.1GB	1MB	10,000	ST39103LW	$355
9.1GB	4MB	10,000	ST39103LW4	$369
18.2GB	1MB	7,200	ST318275LW	$375
18.2GB	1MB	10,000	STST318203LW	$570
18.2GB	4MB	10,000	ST318203LW4	$585
36.4GB	1MB	7,200	ST136475LW	$825
36.4GB	1MB	10,000	ST136403LW	$910
50.1GB	1MB	7,200	ST150176LW	**$915**

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Floppy Drive	USBFLOPPY	$79
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Budget 50 pack	8x	CDR74B-50	$55
Budget 100 pack	8x	CDR74B-100	$99
CDR-74W Rewritable			
Budget 5 pack	4x	CDR74WB-5	$9
Budget 20 pack	4x	CDR74WB-20	$25
Budget 50 pack	4x	CDR74WB-50	$59
Budget 100 pack	4x	CDR74WB-100	$109
CDR-74 Printable			
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Budget 20 pack	4x	CDR74PB-20	$25
Budget 50 pack	4x	CDR74PB-50	$59
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Budget 20 pack	8x	CDR80-20	$25
Budget 50 pack	8x	CDR80-50	$59
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Ricoh 8x4x32 IDE Packet write, 4MB buffer, tray load, writes to CDR (writes once) at 8x, CDRW (rewritable) at 4x, and reads at 32x
Int. drive (RW7080A)/Int. w/software & 1 RW disk (RW7080AK) $219/$239
Yamaha 8x4x24 SCSI Packet write, 4MB buffer
Internal drive (YCRW8X4X24S) $249
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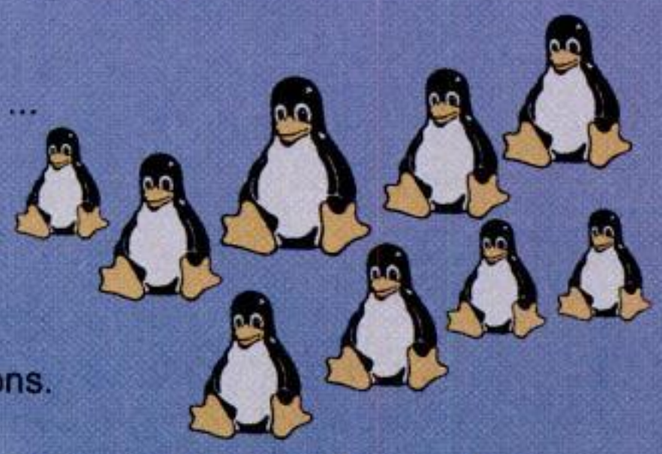

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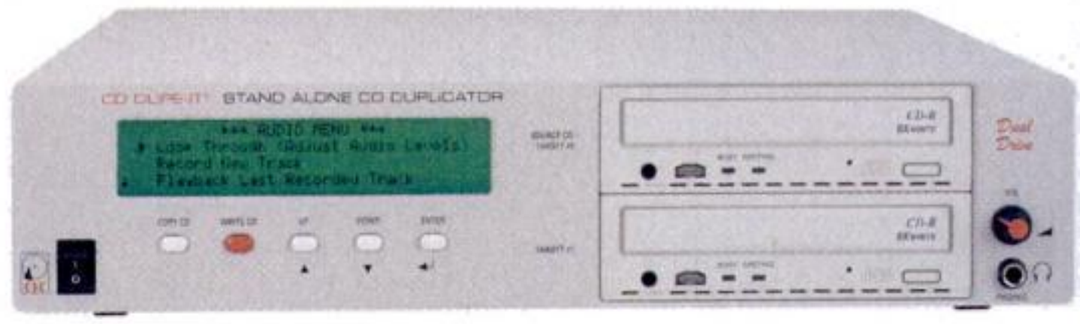

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ABERDEEN 1

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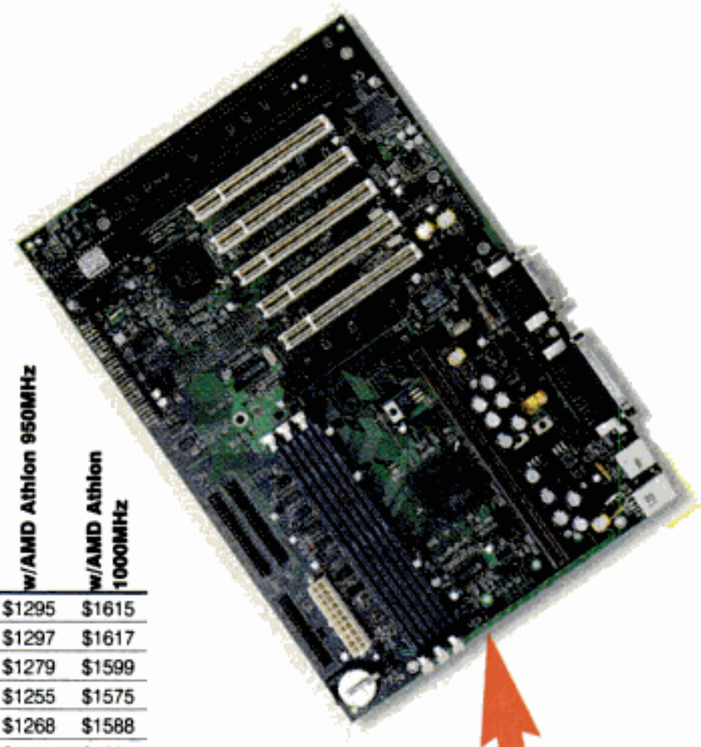
	Part Number	Chip Set	L2 Cache (KB)	Maximum Memory (MB)	168-pin DIMM Sockets	72-pin SIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD-K6®-2/450 with 3DNow!™	w/AMD-K6-2/500	w/AMD-K6-2/550	w/AMD-K6-III/400	w/Intel® Pentium® MMX™ 233MHz
Asus P5A-B	MB5711	ALi Aladdin V	512	384	3		Award			3	2	1	Baby AT	1 Yr.	$95	$149	$154	$185	$185	$140
EPoX EP-MVP3C2	MB5406	VIA Apollo MVP3	512	384	3		Award		UltraDMA/66	4	2	1	Baby AT	2 Yrs.	$81	$135	$140	$171	$171	$126
EPoX EP-MVP3G5	MB5405	VIA Apollo MVP3	2048	384	3		Award		UltraDMA/66	5	2	1	ATX	2 Yrs.	$106	$160	$165	$196	$196	$151
FIC PA-2013 (2MB Cache)	MB5214	VIA Apollo MVP3	2048	384	3		Award			4	2	1	ATX	1 Yr.	$110	$164	$169	$200	$200	$155
FIC VA-503+	MB5211	VIA Apollo MVP3	1024	512	2	4	Award			3	3	1	Baby AT	1 Yr.	$77	$131	$136	$167	$167	$122
Shuttle HOT-591P	MB5611	VIA Apollo MVP3	512	256	2	2	Award			3	3	1	Baby AT	1 Yr.	$77	$131	$136	$167	$167	$122
Tyan S1590S Trinity 100AT	MB5006	VIA Apollo MVP3	1024	384	3	2	Award			4	4	1	Mini AT	3 Yrs.	$95	$149	$154	$185	$185	$140
Tyan S1598 Trinity ATX	MB5008	VIA Apollo MVP3	2048	384	3		Award		UltraDMA/66	5	2	1	ATX	3 Yrs.	$124	$178	$183	$214	$214	$169



Slot A

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Bus Frequency	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/AMD Athlon™ 650MHz	w/AMD Athlon 700MHz	w/AMD Athlon 750MHz	w/AMD Athlon 800MHz	w/AMD Athlon 850MHz	w/AMD Athlon 900MHz	w/AMD Athlon 950MHz	w/AMD Athlon 1000MHz
AMI Megathon	MB7301	AMD-751 / VIA 686A	768	3	Award	100	UltraDMA/66	5	1	1	ATX	1 Yr.	$165	$390	$450	$540	$735	$945	$1185	$1295	$1615
Asus K7M	MB7701	AMD-751 / VIA 686A	768	3	Award	100/120/133	UltraDMA/66	5	1	1	ATX	1 Yr.	$167	$392	$452	$542	$737	$947	$1187	$1297	$1617
EPoX EP-7KXA	MB7850	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	5	1	1	ATX	2 Yrs.	$149	$374	$434	$524	$719	$929	$1169	$1279	$1599
FIC SD11	MB7401	AMD-751 / VIA 686A	768	3	Award	100	UltraDMA/66	5	1	1	ATX	1 Yr.	$125	$350	$410	$500	$695	$905	$1145	$1255	$1575
GVC QS750	MB7601	AMD-750	768	3	Award	100	UltraDMA/66	4	3	1	ATX	1 Yr.	$138	$363	$423	$513	$708	$918	$1158	$1268	$1588
Microstar K7 Pro	MB7202	AMD-750	768	3	Award	100	UltraDMA/66	6	1	1	ATX	1 Yr.	$157	$382	$442	$532	$727	$937	$1177	$1287	$1607
Shuttle AI61	MB7901	AMD-750	768	3	Award	100	UltraDMA/66	5		1	MicroATX	1 Yr.	$125	$350	$410	$500	$695	$905	$1145	$1255	$1575
Tyan S2380 Trinity K7	MB7000	VIA Apollo KX133	768	3	Award	200/133	UltraDMA/66	6	1	1	ATX	3 Yrs.	$179	$404	$464	$554	$749	$959	$1199	$1309	$1629

Socket 370

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	PCI Slots	ISA Slots	AGP Slot	AMR Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Celeron™ processor 500/A MHz 128K OD 66MHz FSB	w/Intel Celeron 566 128K OD 66MHz FSB	w/Intel Celeron 600 128K OD 66MHz FSB	w/Intel Celeron 633 128K OD 66MHz FSB	w/Intel Celeron 667 128K OD 66MHz FSB	w/Dual Intel Celeron 667 128K OD 66MHz FSB	w/Intel Pentium® III 600E/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 667 256K OD 133MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 866 256K OD 133MHz FSB
ABIT BP6 (Dual)	MB6506	Intel 440BX	768	3	Award			5	2	1		ATX	1 Yr.	$131	$217	$256	$296	$336	$361	$591	N/A	N/A	N/A	N/A	N/A
EPoX EP-3VCA	MB6854	VIA Apollo Pro 133A	768	3	Award	AC-97		4	1	1	1	ATX	2 Yrs.	$120	$206	$245	$285	$325	$350	N/A	$350	$420	$520	$790	$1010
Shuttle ME64	MB6310	Intel 810E	512	2	Award	Intel 810E	Intel 810E	3			1	Micro ATX	1 Yr.	$118	$204	$243	$283	$323	$348	N/A	$348	$418	$518	$788	$1008
SuperMicro 370SCD	MB6159	Intel® 820	512	2	AMI	AC-97		5		1	1	ATX	1 Yr.	$147	$233	$272	$312	$352	$377	N/A	$377	$447	$547	$817	$1037
SuperMicro 370SEA	MB6140	Intel 810E	512	2	AMI	Intel 810E	Intel 810E	6	1		1	ATX	1 Yr.	$134	$220	$259	$299	$339	$364	N/A	$364	$434	$534	$804	$1024
Tyan S1857 Trinity 371	MB6017	Intel 440BX	768	3	AMI			6	1	1		ATX	3 Yrs.	$105	$191	$230	$270	$310	$335	N/A	N/A	N/A	N/A	N/A	N/A
Tyan S1854 Trinity 400	MB6018	VIA Apollo Pro 133A	768	3	Award			6	1	1		ATX	3 Yrs.	$108	$194	$233	$273	$313	$338	N/A	$338	$408	$508	$778	$998

Slot 1

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	168-pin RIMM Sockets	Flash BIOS	Integrated Audio	Integrated Controller	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® 600E/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 650 256K OD 100MHz FSB	w/Intel Pentium III 667 256K OD 133MHz FSB	w/Intel Pentium III 700 256K OD 100MHz FSB	w/Intel Pentium III 733 256K OD 133MHz FSB	w/Intel Pentium III 750 256K OD 100MHz FSB	w/Intel Pentium III 800/EB 256K OD 100/133MHz FSB	w/Intel Pentium III 866 256K OD 133MHz FSB	w/Intel Pentium III 1000 256K OD 133MHz FSB	w/Dual Intel Pentium III 850 256K OD 100MHz FSB
ABIT BE6-II	MB6508	Intel 440BX	768	3		Award		UltraDMA/66	5	1	1	ATX	1 Yr.	$140	$370	$430	N/A	$520	N/A	$680	$810	N/A	N/A	N/A
ABIT BF6	MB6507	Intel 440BX	768	3		Award			6	1	1	ATX	1 Yr.	$119	$349	$409	N/A	$499	N/A	$659	$789	N/A	N/A	N/A
ABIT VA6	MB6509	VIA Apollo Pro 133	768	3		Award	AC-97	UltraDMA/66	5	2	1	ATX	1 Yr.	$89	$319	$379	$389	$469	$489	$629	$759	$979	$1269	N/A
Asus P2B98-DS	MB6707	Intel 440BX	1024	4		Award			4	2	1	ATX	1 Yr.	$479	$709	$769	N/A	$859	N/A	$1019	$1149	N/A	N/A	$2219
Asus P3B-F	MB6720	Intel 440BX	1024	4		Award			6	1	1	ATX	1 Yr.	$133	$363	$423	N/A	$513	N/A	$673	$803	N/A	N/A	N/A
Asus P3C2000	MB6722	Intel 820	1024	4		Award	AC-97	UltraDMA/66	5	1	1	ATX	1 Yr.	$170	$400	$460	$470	$550	$570	$710	$840	$1060	$1350	N/A
Asus P3V4X	MB6723	VIA Apollo Pro 133A	1024	4		Award		UltraDMA/66	6	1	1	ATX	1 Yr.	$121	$351	$411	$421	$501	$521	$661	$791	$1011	$1301	N/A
EPoX EP-6VBA2	MB6855	VIA Apollo Pro 133A	768	3		Award	AC-97	UltraDMA/66	4	2	1	ATX	2 Yrs.	$109	$339	$399	$409	$489	$509	$649	$779	$999	$1289	N/A
FIC KA11	MB6411	VIA Apollo Pro 133A	1024	4		Award		UltraDMA/66	5	2	1	ATX	1 Yr.	$100	$330	$390	$400	$480	$500	$640	$770	$990	$1280	N/A
Intel CC820	MB6919	Intel 820	512	2		Intel/Phoenix		UltraDMA/66	5		1	ATX	3 Yrs.	$153	$383	$443	$453	$533	$553	$693	$823	$1043	$1333	N/A
Intel VC820	MB6920	Intel 820	512		2	Intel/Phoenix		UltraDMA/66	5		1	ATX	3 Yrs.	$179	$409	$469	$479	$559	$579	$719	$849	$1069	$1359	N/A
Intel SE440BX-2 "Seattle"	MB6921	Intel 440BX	768	3		Intel/Phoenix			4	2	1	ATX	3 Yrs.	$115	$345	$405	N/A	$495	N/A	$655	$785	N/A	N/A	N/A
Shuttle AV64	MB6309	VIA Apollo Pro 133A	768	3		Award		UltraDMA/66	5	2	1	ATX	1 Yr.	$94	$324	$384	$394	$474	$494	$634	$764	$984	$1274	N/A
SuperMicro PIIISCD	MB6146	Intel 820	512	2		AMI	AC-97	UltraDMA/66	5		1	ATX	1 Yr.	$152	$382	$442	$452	$532	$552	$692	$822	$1042	$1332	N/A
SuperMicro PIIISED	MB6142	Intel 810e	512	2		AMI	AC-97	UltraDMA/66	6			ATX	1 Yr.	$123	$353	$413	$423	$503	$523	$663	$793	$1013	$1303	N/A
SuperMicro PIIIDME	MB6151	Intel 840	4096	4		AMI	AC-97	Intel PRO/100+	6		1	ATX	1 Yr.	$359	$589	Call	$659	Call	$759	Call	Call	$1249	$1539	Call
SuperMicro PIIIDM3	MB6153	Intel 840	4096	4		AMI	AC-97	Adaptec Ultra3/160	6		1	ATX	1 Yr.	$599	$829	$889	N/A	$979	N/A	$1139	$1269	N/A	N/A	$2339
SuperMicro P6DGH	MB6129	Intel 440GX	2048	4		AMI		Adaptec 2-Ch U2W	9	2	1	Full AT	1 Yr.	$835	$1065	$1125	N/A	$1215	N/A	$1375	$1505	N/A	N/A	$2575
SuperMicro P6SBA	MB6120	Intel 440BX	768	3		AMI			4	3	1	ATX	1 Yr.	$104	$334	$394	N/A	$484	N/A	$644	$774	N/A	N/A	N/A
SuperMicro P6SBU	MB6128	Intel 440BX	1024	4		AMI		Adaptec U2W	4	3	1	ATX	1 Yr.	$329	$559	$619	N/A	$709	N/A	$869	$999	N/A	N/A	N/A
Tyan S1854 Trinity 400	MB6018	VIA Apollo Pro 133A	768	3		Award		UltraDMA/66	6	1	1	ATX	3 Yrs.	$109	$339	$399	$409	$489	$509	$649	$779	$999	$1289	N/A

Slot 2

	Part Number	Chip Set	Maximum Memory (MB)	168-pin DIMM Sockets	Flash BIOS	Integrated Audio	Integrated Video	Integrated Controller	Integrated Networking	PCI Slots	ISA Slots	AGP Slot	Format	Manufacturer's Warranty	Motherboard Only	w/Intel® Pentium III® Xeon™ 550MHz 512K 100MHz FSB	w/Intel Xeon 550MHz 1M 100MHz FSB	w/Intel Xeon 550MHz 2M 100MHz FSB	w/Dual Intel Xeon 550MHz 512K 100MHz	w/Quad Intel Xeon 550MHz 512K 100MHz	w/Intel Xeon 700MHz 1M 100MHz FSB	w/Intel Xeon 733MHz 256K OD 133MHz FSB	w/Intel Xeon 866MHz 256K OD 133MHz FSB
AMI MegaPlex II	MB6215	Intel 450NX	4096	16	AMI	2MB ATI				7	1		9U Rack	1 Yr.	$3999	$5099	$6329	$8339	$6199	$8399	N/A	N/A	N/A
SuperMicro S2DM3	MB6156	Intel 840	4096	4	AMI	AC-97		Adaptec Ultra3/160m	Intel PRO/100+	6		1	ATX	1 Yr.	$676	$1776	$3006	$5016	$2876	N/A	$2076	$1176	$1626
SuperMicro S2DME	MB6160	Intel 840	4096	4	AMI	AC-97			Intel PRO/100+	6		1	ATX	1 Yr.	$446	$1546	$2776	$4786	$2646	N/A	$1846	$946	$1396
SuperMicro S2DG2	MB6136	Intel 440GX	2048	4	AMI			Adaptec 2-Ch U2W		5	2	1	ATX	1 Yr.	$549	$1649	$2879	$4889	$2749	N/A	$1949	N/A	N/A
SuperMicro S2DGE	MB6135	Intel 440GX	2048	4	AMI					5	2	1	ATX	1 Yr.	$329	$1429	$2659	$4669	$2529	N/A	$1729	N/A	N/A
SuperMicro S2QR6	MB6190	Reliance HE	16384	16	AMI			AIC-7899 2-Ch Ultra160	Intel 82559	8			SWTX	1 Yr.	$2732	$3832	$5062	$7072	$4932	$7132	$4132	N/A	N/A

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- Clone from 1 to 15 drives at once
- Master & target drives can be of different size, brand and model
- Master drive can hold up to 24 partitions
- Selective partitions: select one, some or all
- Bi-directional data transfer for forensic applications
- Comprehensive data recovery and drive wipe to DoD specs

1 Source → 1 Target

OMNICLONE SOLITAIRE

The Logicube OmniClone Solitaire is one of the most advanced one-to-one drive duplication solution on the market today.

- Single target, IDE hard drive to hard drive duplication
- Portable—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Master & target drives can be of different size, brand and model
- Master can hold up to 24 partitions
- Selective partitions - Choose one or more partitions to copy
- Reverse data transfer - clone from target to master
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features - data recovery, drive wipe, and scanning
- Clone both ways thru a parallel port connection
- Includes carrying case, tools, cables, manual

$845
HDP500

1 Source → 2 Targets

OMNICLONE REPLIQUE 2

The OmniClone Replique 2 is the most portable way to copy to two native target drives.

- Dual target, IDE hard drive to hard drive duplication
- Compact—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Durable design—Metal case and heavy-duty removable hinge
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Removable lid for easy use
- Easily upgraded to Replique 5 with the Replique 2 Expansion Station (Targets 3,4 & 5) *(HDP502)* for $1795.00

$1,995
HDP501

1 Source → 5 Targets

OMNICLONE REPLIQUE 5

The Replique 5 package is a complete one-to-five solution, just plug it in and clone!

- Five target, IDE hard drive to hard drive duplication
- Compact—Smallest unit on the market
- Data transfer speeds exceed 800 MB/min
- Durable design—Metal case and heavy-duty removable hinge
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Modular—If one unit fails, you still have a 1 to 2

$3,650
HDP503

3 Sources → 15 Targets

OMNICLONE REPLIQUE 15

OmniClone Replique 15 clones up to 15 drives at once. The units can be detached and reassigned to fit workload needs. Comes with space saving docking station with sliding ball-bearing shelves.

- Fifteen target, three master, IDE hard drive to hard drive duplication
- Compact—Smallest unit on the market
- Data transfer speeds exceed 600 MB/min
- Durable design - Metal case and heavy-duty, ball bearing slides
- Any operating system—Scales FAT16, FAT32, and NTFS
- Comprehensive diagnostics features—data recovery, drive wipe, and scanning
- Modular—If one unit fails, you only lose two targets

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HDP505

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Replique 2 NTFS Clever Copy *HDP509* $395.00
Replique 2 OmniDiagnose *HDP510* $395.00
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Replique 10/15 OmniPrint *HDP518* $395.00
Replique 10/15 NTFS Clever Copy *HDP519* $395.00
Replique 10/15 OmniDiagnose *HDP520* $395.00
Replique 10/15 Clone Pack (includes all options) *HDP521* $1295.00
Replique 10/15 Extended Warranty (2 Years Total) *HDP533* $795.00
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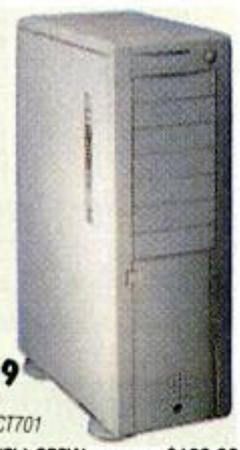

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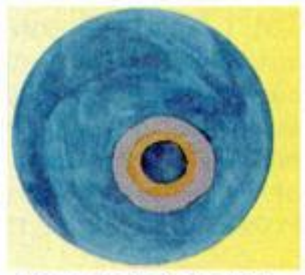

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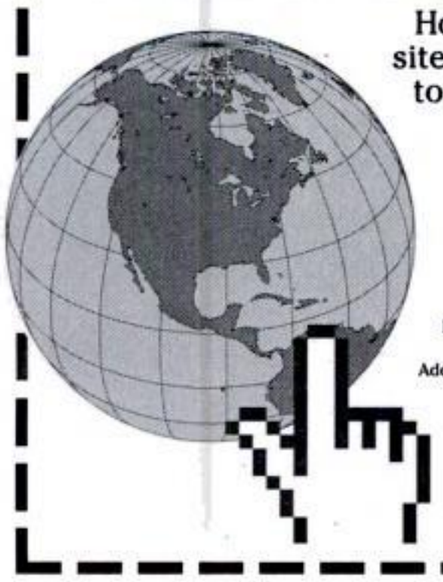

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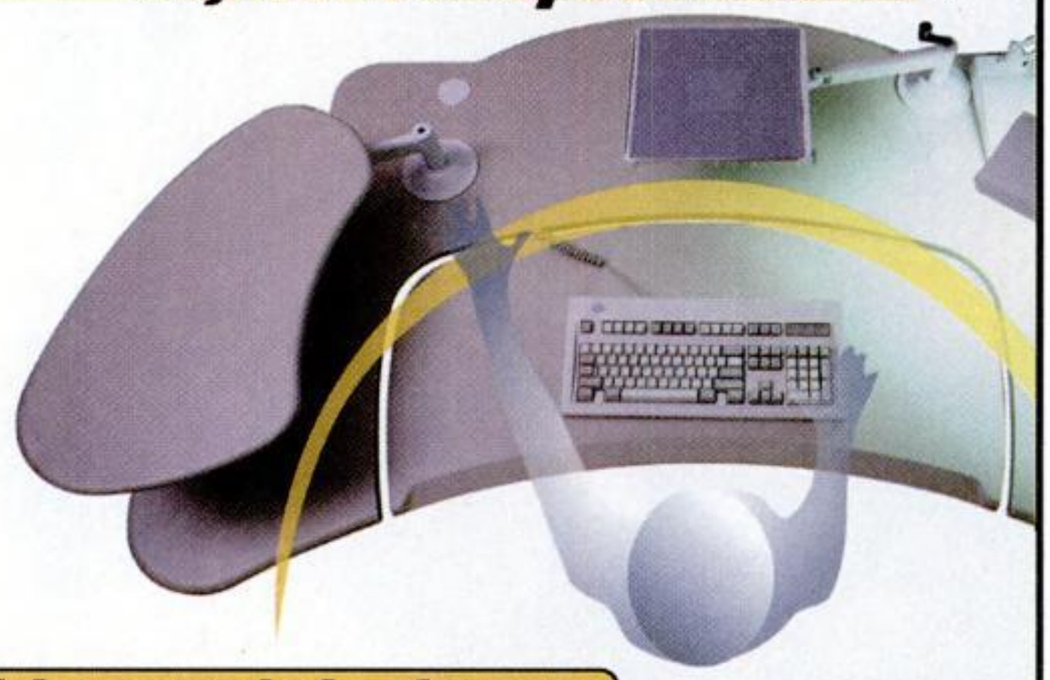

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Alternative OS Digest

"Serving Non-Conformist Geeks Since 1982"

OS/2 Deemed "Irrelevant" By Pan-OS Council

At their annual Relevancy Tribunal in Knoxville, Tenn. last week, the Pan-Operating System Council of Elders officially declared OS/2 "Operata Non-Grata." Though still very popular in Uganda and pockets of southern Sudan, OS/2 has faced dwindling user population counts on U.S. soil.

The Council estimates there are currently 60 active OS/2 users on the west coast, 55 active users on the east coast, and another 35 to 45 active users nesting in underground hovels and effluvial drainage pipes throughout the rest of the country. The Council's tallies do not include the 27 users working in the computer lab of the Mennonite Deprogramming Center in Lancaster, Penn. because the lab is still using the 16-bit version of the operating system, and has no plans to upgrade.

"OS/2 is dead to us," stated Council Prefect Lloyd Petersen. "It is irrelevant. It is a non-entity. And we will never utter its name ever again, starting… right… now."

Apple Owner's Car Doesn't Drive to Suisun City

Apple Macintosh fanatic Corey Porter, the proud new owner of a Sashimi Scamp sports coupe, was quite dismayed to find that his car will not drive to Suisun City.

"I won't lie to you," said Porter, "I'm flat-out mad. I mean, the car looked so cute in the showroom with its blueberry paint job, and I figure it's a car, right, so it should go anywhere. But it won't make the trip from my condo in Vallejo to my job in Suisun City. I mean the car works and all—it's a new car!—it just doesn't drive to Suisun City."

Porter is one of many Apple Macintosh fanatics who've discovered that the Sashimi Scamp does not support travel to certain locations in the United States and Canada. The Digest recommends that prospective Scamp owners research travel restrictions before buying the car. In addition to poor destination support, the Scamp also lacks support for speeds above 70 mph and three consecutive right turns in a row.

In a related story, Porter patted himself on the back for having installed his 1,000th font on his cute-as-a-button tangerine iMac. "I'm going to make a party invitation with it!," Porter said.

Amiga Cedes Copyright to Own Name

Use it or lose it. That's the message Nintendo sent to the Amino Development Corporation when it adopted the name "Amiga" for one its new Pokemon characters.

Fans of the Amiga computing platform know that Amino bought all Amiga products from Gateway during the last week of 1999. Since then, Amino has barely touched its Amiga gear, and actually moved it all into the hallway closet to make room for its new recumbent bicycle, which it also hasn't touched in months.

Now, some four and a half months after Amino's original Amiga purchase, Nintendo has adopted the Amiga name for its new Fire-type Pokemon character. The new character's wily arsenal of special attacks includes Roar, Ember, and Take Down. Amiga, however, is highly vulnerable to attacks from Ground-, Rock- and Water-type pocket monsters.Ironically enough, Amino was playing Mario Kart 64 when Nintendo barged in and appropriated the name. "Yeah, yeah, whatever," said Amino. "It's all in the hall closet. Take it, sure."

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Mac OS 9

Be

INSIDE:

- Linux User Recompiles Kernel; Wonders "What's Next?"
- BeOS Freak Plays Audio File Backwards to Amuse Friends
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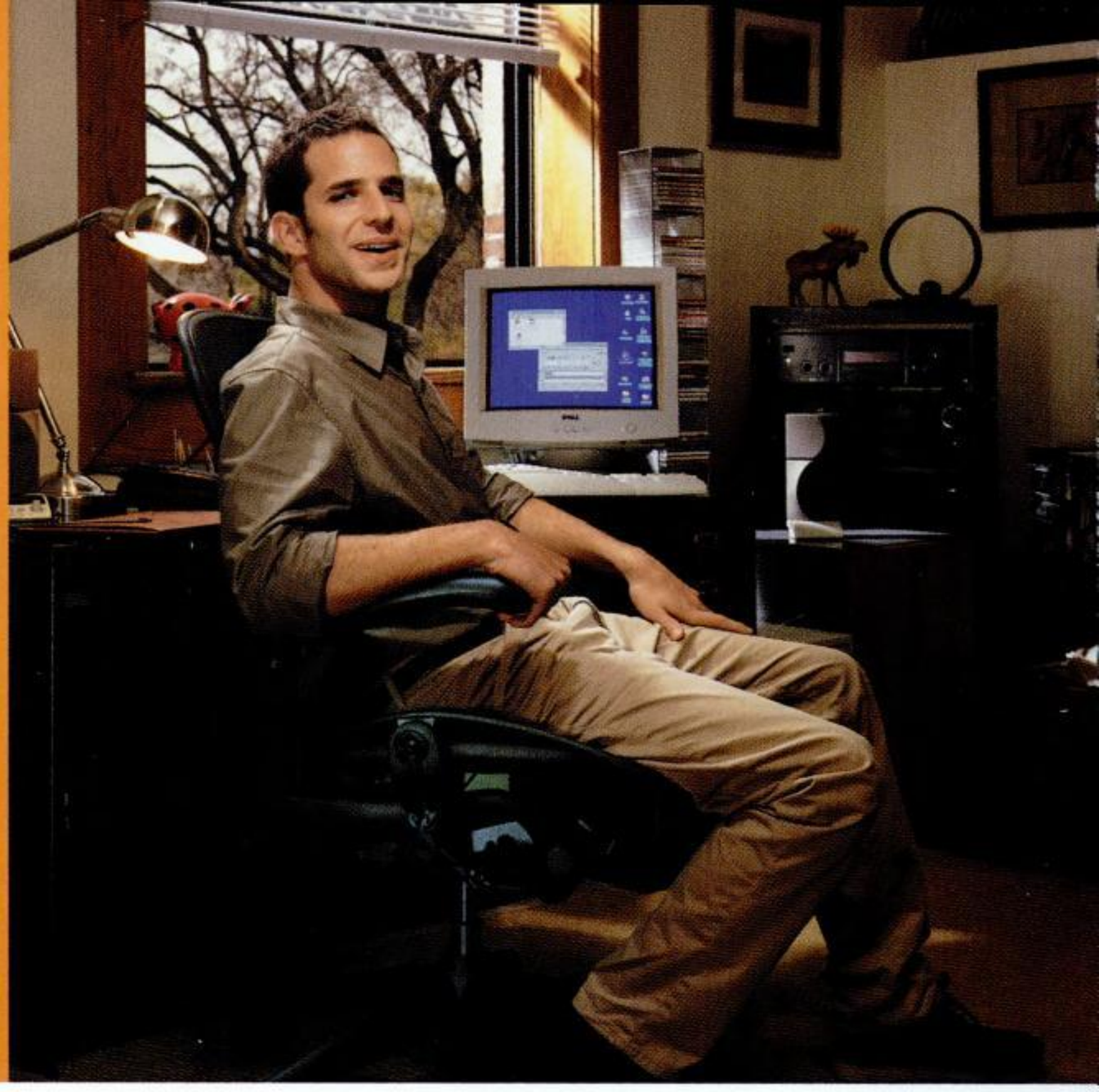

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